

AD-A138 642

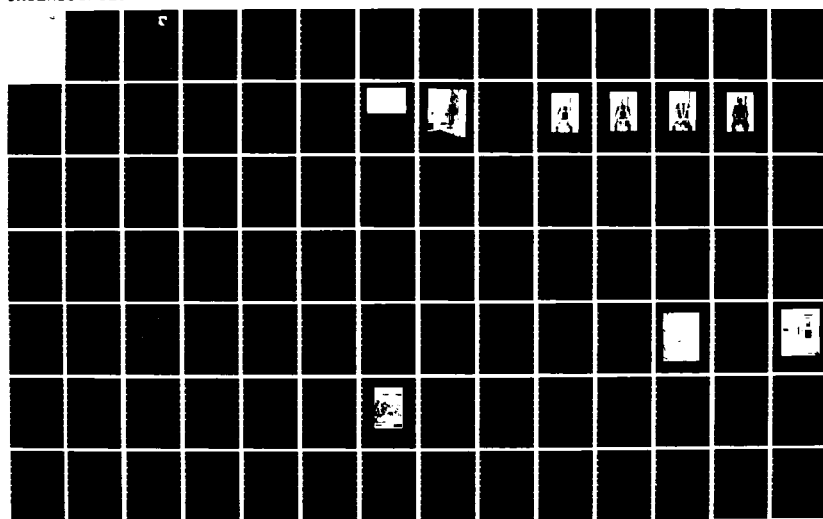
EFFECTS OF A NEGATIVE G STRAP ON RESTRAINT DYNAMICS AND  
HUMAN IMPACT RESPONSE(U) AIR FORCE AEROSPACE MEDICAL  
RESEARCH LAB WRIGHT-PATTERSON AFB. B F HEARON ET AL.  
DEC 83 AFAMRL-TR-83-083

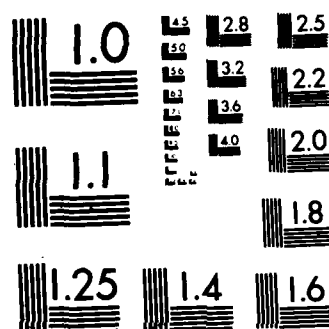
1/4

UNCLASSIFIED

F/G 6/17

NL





MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS-1963-A

AFAMRL-TR-83-083



## EFFECTS OF A NEGATIVE G STRAP ON RESTRAINT DYNAMICS AND HUMAN IMPACT RESPONSE

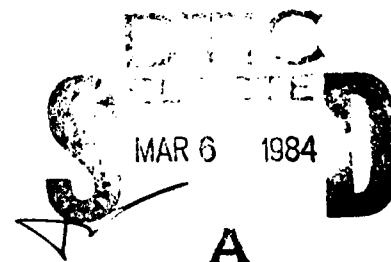
*BERNARD F. HEARON, MAJOR, USAF, MC, FS*

*JAMES W. BRINKLEY  
DAVID M. HUDSON, 1LT, USAF  
WILLIAM J. SAYLOR, CMSGT, USAF*

DECEMBER 1983

Approved for public release; distribution unlimited.

AIR FORCE AEROSPACE MEDICAL RESEARCH LABORATORY  
AEROSPACE MEDICAL DIVISION  
AIR FORCE SYSTEMS COMMAND  
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433



DTIC FILE COPY

84 00

09

## NOTICES

When US Government drawings, specifications, or other data are used for any purpose other than a definitely related Government procurement operation, the Government thereby incurs no responsibility nor any obligation whatsoever, and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise, as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Please do not request copies of this report from Air Force Aerospace Medical Research Laboratory. Additional copies may be purchased from:

National Technical Information Service  
5285 Port Royal Road  
Springfield, Virginia 22161

Federal Government agencies and their contractors registered with Defense Technical Information Center should direct requests for copies of this report to:

Defense Technical Information Center  
Cameron Station  
Alexandria, Virginia 22314

## TECHNICAL REVIEW AND APPROVAL

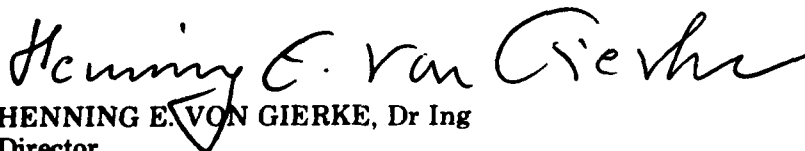
AFAMRL-TR-83-083

The voluntary informed consent of the subjects used in this research was obtained as required by Air Force Regulation 169-3.

This report has been reviewed by the Office of Public Affairs (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

**FOR THE COMMANDER**



HENNING E. VON GIERKE, Dr Ing  
Director  
Biodynamics and Bioengineering Division  
Air Force Aerospace Medical Research Laboratory



REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER AFAMRL-TR-83-083	2. GOVT ACCESSION NO. AD-A138642	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) EFFECTS OF A NEGATIVE G STRAP ON RESTRAINT DYNAMICS AND HUMAN IMPACT RESPONSE		5. TYPE OF REPORT & PERIOD COVERED Technical Report
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Bernard F. Hearon      David M. Hudson James W. Brinkley      William J. Saylor		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Air Force Aerospace Medical Research Laboratory, Aerospace Medical Division, Air Force Systems Command, Wright-Patterson AFB, Ohio 45433		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 62202F/7231/16/AG
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE December 1983
		13. NUMBER OF PAGES 373
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Biomechanical Protection      Vertical Seat Loads Impact Acceleration      Man-Seat Coupling PCU-15/P Torso Harness      Torso Submarining Negative G or Crotch Strap      Volunteer Subjects		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) A test program to assess the influence of a negative G strap on restraint dynamics and human impact response was conducted. One-hundred and eighty-two impact tests with volunteer subjects were performed in eight different test conditions. Forward facing impacts were conducted on the AFAMRL Horizontal Impulse Accelerator up to a level of 10 G peak (30 ft/sec). Vertical impact tests were conducted on the AFAMRL Vertical Deceleration Tower up to a level of 10 G peak (26 ft/sec). Subjects were restrained to the test vehicle using either the		

Block 20. (continued)

PCU-15/P torso harness and lap belt or a conventional double shoulder strap and lap belt configuration. In one half of the test conditions, negative G straps were incorporated into these restraint systems, while in the other test conditions the unmodified restraint systems were evaluated. Measured data included test vehicle acceleration and velocity change, head and chest translational acceleration components, triaxial forces acting at the restraint strap attachment fittings and at the seat, and body segment displacements. Analysis of the test results was accomplished using the Wilcoxon paired-replicate rank test. Adding the negative G strap to either restraint system had clearly beneficial effects. These included decreasing the tendency toward submarining in forward facing impacts, providing better occupant-seat coupling during free fall, and improving vertical impact protection. However, when added to the conventional configuration, the negative G or crotch strap increased the vertical seat loads, indicating either transmission of negative G strap tension through the pelvis to the seat or increased vertebral column loading. Nevertheless, sufficient benefits appear to result from use of the negative G strap to warrant a recommendation for its incorporation into selected USAF restraint systems, such as the PCU-15/P torso harness and lap belt. Additional data analysis revealed that the conventional double shoulder strap and lap belt restraint provided better forward facing and vertical impact protection than the PCU-15/P torso harness and lap belt configuration. Further research at AFAMRL is planned to identify restraint harness features which may improve the performance of current and future impact protection systems.



Date	
Time	
Location	
Inspector	
Dist	
Remarks	
AI	

## PREFACE

This research effort was accomplished under a Memorandum of Agreement between the Life Support System Program Office (SPO) of the Aeronautical Systems Division and the Air Force Aerospace Medical Research Laboratory (AFAMRL) of the Aerospace Medical Division. The program managers for the Life Support SPO were Mr. Michael W. Higgins and Mr. John Kick.

The test program was conducted by members of the Biomechanical Protection Branch, Biodynamics and Bioengineering Division of AFAMRL. This report describes the research objectives of the test program and the methods used to accomplish the experiments, presents and analyzes the collected data, summarizes the results of the evaluation, and provides recommendations.

The authors wish to express their gratitude to the Branch personnel who participated in the planning, preparation, and implementation of these experiments and those who assisted in the preparation of this technical report. Special recognition is given to Capt Thomas J. Jennings for his medical supervision of the volunteer subjects and medical monitoring of the experiments; MSgt Dale Schimmel for serving as test conductor; Sgt Daniel J. Beachy for serving as safety monitor; and Mrs. Rosalee J. Combs for her administrative support in the preparation of this documentation. Thanks is also expressed to Lt Col James H. Raddin, Jr. for assistance provided in preparing this report.

The impact facilities and data collection equipment were operated by the Scientific Services Division of the Dynalelectron Corporation under USAF Contract F33615-79-C-0523. Mr. Harold F. Boedeker served as the Engineering Supervisor for the Dynalelectron Corporation. The efforts of Mr. Boedeker and Mr. Wesley Waldron in preparing Appendix B as well as those of Mr. Robert Flannery and Mr. Steven Mosher in processing the electronic, photometric and subjective data are gratefully acknowledged.

Photographic support was provided by the Technical Photographic Division of the 4950th Test Wing. Special thanks are offered to the many personnel who operated the high-speed motion picture cameras and who provided still photography coverage for the tests in this study.

Anthropometric measurements of the test subjects were collected by Dr. Kenneth W. Kennedy, Mr. Charles E. Clauser, and Lt Col Maureen Lofberg of the Workload and Ergonomics Branch, Human Engineering Division of AFAMRL. The assistance of these individuals is gratefully acknowledged.

Special commendation is also given to the USAF officers and enlisted personnel who volunteered to participate in these impact experiments. The success of this investigation was due to the continuing interest and enthusiastic support of these volunteers and to the devotion and professionalism of the entire team of government and contractor personnel.

## TABLE OF CONTENTS

	Page
PREFACE	1
TABLE OF CONTENTS	2
LIST OF FIGURES	3
LIST OF TABLES	4
SUMMARY	6
 1 INTRODUCTION	
A Background	9
B Program Objectives	11
 2 TECHNICAL APPROACH	
A Experimental Design	12
B Test Configuration	14
C Evaluation Criteria	22
 3 TEST RESULTS AND ANALYSIS	
A Overview	26
B Horizontal Test Phase: Electronic and Photometric Data	27
C Vertical Test Phase: Electronic Data	36
D Medical Findings	43
E Subjective Data	45
 4 DISCUSSION	
A Negative G Strap Effects	48
B Restraint Harness Effects	51
C Technical Notes	52
 APPENDIX A	
Use of Human Subjects	56
APPENDIX B	
Test Facilities and Equipment	61
APPENDIX C	
Summary of Electronic Data	80
APPENDIX D	
Electronic Data Analysis	291
APPENDIX E	
Photometric Data	353
 REFERENCES	368

## LIST OF FIGURES

	Page
1 Test Fixture for Horizontal Test Phase	15
2 Test Fixture for Vertical Test Phase	16
3 PCU-15/P Torso Harness and Lap Belt Configuration Used in Test Conditions C and G	18
4 PCU-15/P Torso Harness and Lap Belt Configuration with an Added Negative G Strap Used in Test Conditions D and H	19
5 Conventional Double Shoulder Strap and Lap Belt Configuration Used in Test Conditions A and E	20
6 Conventional Double Shoulder Strap and Lap Belt Configuration with an Added Negative G Strap Used in Test Conditions B and F	21
7 Comparison of Measured Horizontal Seat Load and Corresponding Computed Tare Load for a Typical Forward Facing Test	53
B-1 Horizontal Impulse Accelerator	62
B-2 HYGE Actuator of the Horizontal Impulse Accelerator	63
B-3 Vertical Deceleration Tower and Test Fixture	64
B-4 Accelerometer Coordinate System	70
B-5 Seat Pan Instrumentation	71
B-6 Load Link Instrumentation	72
B-7 Seat Load Instrumentation Coordinate System for the Horizontal Test Phase	73
B-8 Seat Load Instrumentation Coordinate System for the Vertical Test Phase	74
B-9 Automatic Data Acquisition and Control System	76
B-10 Data Acquisition and Storage	77
B-11 Automatic Film Reader	79
E-1 Fiducial Placement During Horizontal Test Phase	359
E-2 Fiducial Placement During Vertical Test Phase	360

# LIST OF TABLES

	Page
1 Experimental Design Matrix for Horizontal Test Phase	12
2 Experimental Design Matrix for Vertical Test Phase	13
3 Horizontal Test Phase Electronic Data: Negative G Strap Effects	30
4 Horizontal Test Phase Photometric Data: Negative G Strap Effects	31
5 Horizontal Test Phase Electronic Data: Restraint Harness Effects	34
6 Horizontal Test Phase Photometric Data: Restraint Harness Effects	35
7 Vertical Test Phase Electronic Data: Negative G Strap Effects	37
8 Vertical Test Phase Electronic Data: Restraint Harness Effects	40
9 Horizontal Test Phase: Frequency of Subjective and Objective Medical Findings	43
10 Vertical Test Phase: Frequency of Subjective and Objective Medical Findings	45
A-1 Individual Subject Anthropometry	59
A-2 Collective Subject Anthropometry	60
B-1 Digital Instrumentation Requirements for Horizontal Test Phase	66-67
B-2 Digital Instrumentation Requirements for Vertical Test Phase	68-69
C-1 Means and Standard Deviations of Electronically Measured and Computed Data from Horizontal Test Phase	81
C-2 Means and Standard Deviations of Electronically Measured and Computed Data from Vertical Test Phase	82-83
D-1 Summary of Electronically Measured and Computed Data from Wilcoxon Comparison A-B	293
D-2 Summary of Electronically Measured and Computed Data from Wilcoxon Comparison C-D	294

# LIST OF TABLES (continued)

	Page
D-3 Summary of Electronically Measured and Computed Data from Wilcoxon Comparison A-C	295
D-4 Summary of Electronically Measured and Computed Data from Wilcoxon Comparison B-D	296
D-5 Summary of Electronically Measured and Computed Data from Wilcoxon Comparison E-F	297
D-6 Summary of Electronically Measured and Computed Data from Wilcoxon Comparison G-H	298
D-7 Summary of Electronically Measured and Computed Data from Wilcoxon Comparison E-G	299
D-8 Summary of Electronically Measured and Computed Data from Wilcoxon Comparison F-H	300
E-1 Head and Knee Displacements from Horizontal Test Phase	355-358

## SUMMARY

### RESEARCH OBJECTIVES

1. To evaluate the effects on human impact response of negative G strap incorporation into restraint systems. (Section 1B).
2. To evaluate human impact response in the PCU-15/P torso harness and lap belt configuration compared to such response in a conventional double shoulder strap and lap belt configuration. (Section 1B).
3. To obtain human impact response data for use in present and future mathematical modeling efforts which are intended to predict human inertial response to impact. (Section 1B).

### TEST PROGRAM

1. Twenty-one volunteer subjects were medically qualified to participate in this study. Qualification and utilization of these subjects were in accordance with applicable human use guidelines and regulations, notably AFR 169-3 (Section 2A, Appendix A).
2. Four restraint configurations were evaluated. These were the PCU-15/P torso harness and lap belt with and without an added negative G strap and a conventional double shoulder strap and lap belt configuration with and without an added negative G strap (sections 2A and 2B).
3. Forward facing ( $-G_x$ ) impact tests were conducted on the AFAMRL Horizontal Impulse Accelerator. One-hundred and one tests were performed at acceleration levels up to the experimental level of 10 G peak (30 ft/sec). A generic test seat and fixture were used in which the seat back was reclined 13 degrees from vertical and the seat pan inclined up 6 degrees from horizontal (Section 2B, Appendix B).
4. The vertical ( $+G_z$ ) impact tests were conducted on the AFAMRL Vertical Deceleration Tower. Eighty-one tests were performed at acceleration levels up to the experimental level of 10 G peak (26 ft/sec). These were accomplished in a generic test seat and fixture with a 90 degree seat back, the impact vector being applied parallel to the long axis of the vertebral column (Section 2B, Appendix B).
5. Pertinent accelerations, velocities, and loads were measured electronically. Subject motion was documented by high-speed cameras. Appropriate physiologic data were recorded. Subjective data were obtained by means of a post-test questionnaire. (See sections 2A, 2B, and 3E; appendices A and B.)
6. Electronic and photometric data analysis was accomplished using the Wilcoxon paired-replicate rank test. For the electronic data, the 95% confidence level was chosen as the level of statistical significance, assuming a two-tailed test. For the photometric data, the more liberal 90% confidence level was selected (Section 2C).



## RESULTS FROM HORIZONTAL TEST PHASE

1. Adding the negative G strap to the PCU-15/P torso harness and lap belt configuration resulted in significantly lower vertical and resultant knee displacements, suggesting a reduction in the tendency toward submarining (Section 3B).
2. Adding the negative G strap to the conventional double shoulder strap and lap belt configuration resulted in significantly lower component and resultant knee displacements, also indicating that torso submarining was less likely with the added negative G strap. However, associated findings included significantly higher -X chest acceleration, chest Severity Index, and vertical seat load (Section 3B).
3. Significantly higher component and resultant chest accelerations and chest Severity Index were found in the PCU-15/P configuration compared to conventional configuration, regardless of negative G strap. The PCU-15/P configuration, therefore, provides less adequate fore-aft impact protection in the conventional restraint (Section 3B).
4. There were no clinically consequential medical adverse effects during the horizontal test phase. In particular, no medical contraindications to negative G strap incorporation were found (Section 3D).
5. In the static pre-test condition, higher shoulder strap and lap belt pressures were generally perceived by subjects in the PCU-15/P configuration. During impact, higher shoulder strap pressures were generally perceived by subjects in the conventional configuration with the added negative G strap than in the conventional configuration without the negative G strap (Section 3E).

## RESULTS FROM VERTICAL TEST PHASE

1. Adding the negative G strap to the PCU-15/P configuration resulted in higher vertical and resultant seat loads during carriage free fall, indicating better occupant-seat coupling. Furthermore, vertical and resultant seat loads were significantly less during impact, demonstrating improved vertical impact protection with the added negative G strap (Section 3C).
2. Adding the negative G strap to the conventional configuration also resulted in significantly higher vertical and resultant seat loads during carriage free fall, again indicating better occupant-seat coupling. During impact, resultant head and chest accelerations and the associated Severity Indices as well as vertical and resultant seat loads were all significantly less with the negative G strap, thus demonstrating improved vertical impact protection (Section 3C).
3. During carriage free fall, significantly lower vertical and resultant seat loads were found in the PCU-15/P configuration, indicating less adequate occupant-seat coupling than in the conventional restraint. During impact, significantly higher resultant chest acceleration, chest Severity Index, and vertical and resultant seat loads were observed in the PCU-15/P configuration, demonstrating less adequate vertical impact protection than in the conventional

configuration. These findings were true regardless of negative G strap (Section 3C).

4. There were no clinically consequential medical adverse effects observed during the vertical test phase. In particular, no medical contraindications to negative G strap incorporation were discovered (Section 3D).

5. In both static and dynamic conditions, subjects generally perceived higher shoulder strap and lap belt pressures in the PCU-15/P configuration than in the conventional restraint (Section 3E).

## CONCLUSIONS

1. Negative G strap incorporation into the PCU-15/P configuration is clearly beneficial. The test results demonstrate that use of the crotch strap in this restraint configuration decreases the tendency towards submarining during forward facing impacts, provides better occupant-seat coupling in a free fall environment, and improves vertical impact protection (Section 4A).

2. The available experimental and operational ejection data suggest that a single negative G strap may be incorporated into the PCU-15/P configuration with the expectation that impact-related genital or groin injuries will not significantly increase (Section 4A).

3. Negative G strap incorporation into the conventional configuration also has beneficial effects. The crotch strap, when added to this restraint system, decreases the tendency toward submarining in frontal impacts, provides better occupant-seat coupling during free fall, and improves vertical impact protection. However, in addition, it may degrade fore-aft impact protection in one respect by increasing the vertical seat load (Section 4A).

4. The conventional configuration is clearly superior to the PCU-15/P configuration as a fore-aft and vertical impact protection device (Section 4B).

## RECOMMENDATIONS

1. Addition of a negative G strap to the PCU-15/P torso harness and lap belt configuration is recommended (Section 4A).

2. Further forward facing impact tests with volunteer subjects are recommended to explore the inverted V strap as a protection device (Section 4A).

3. Further vertical impact tests with volunteer subjects are suggested to explore the utility of the inverted V strap and to perform a direct comparison of the F/FB-111 restraint system to the conventional configuration with an added negative G strap (sections 4A and 4B).

4. Further forward facing and vertical impact tests with volunteer subjects are recommended to evaluate and compare other restraint systems in addition to those examined in this study (Section 4B).

## SECTION 1

### INTRODUCTION

#### A. BACKGROUND

One of the intended purposes of a negative G strap is to prevent "submarining" or movement of the torso under the lap belt during  $-G_x$  impacts. By tethering the lap belt to the forward portion of the seat, the negative G or crotch strap prevents the lap belt from riding up and over the anterior superior iliac crests, pressing against the abdomen, and causing serious internal injury. Operationally, such forward facing impact accelerations may be experienced by aircrew members during aircraft crashes and during the aerodynamic deceleration immediately following emergency ejections.

Stapp (1951) conducted impact experiments with human subjects restrained by harness configurations with and without anti-submarining straps. He reported that test subjects reached the threshold of voluntary tolerance at 17 G with a velocity change greater than 98 ft/sec when they were restrained by a lap belt and double shoulder strap harness configuration. In these tests, Stapp stated that "the forward motion of the shoulders during impact applies traction to the shoulder straps, raising the lap belt, permitting the lower half of the body to begin bending around it. The upper edge of the belt lodges against the lower margins of the ribs and against the upper abdomen". One of the subjects participating in these experiments "sustained a broken rib cartilage at about 12 G". The higher acceleration tests performed by Stapp that are more frequently cited were accomplished using a pair of crotch straps to prevent the lap belt from riding up and over the iliac crests. Each crotch strap was attached to an adjacent rear corner of the seat and to the lap belt buckle to form an inverted-V. These straps carried the tension loads of the shoulder straps into the subject's pelvis and the seat structure.

A second purpose of the negative G strap is to provide better mechanical coupling between aircrew member and seat during low frequency flight vibrations, sustained  $-G_z$  acceleration maneuvers, and adverse aircraft motions, which occur if the aircraft departs from controlled flight. For example, during sustained  $-G_z$  acceleration, aircrew members using standard restraint systems without a crotch strap may experience helmet-canopy contact. Recently, an F-4 pilot incurred a cervical fracture with neurologic sequelae as the result of such acceleration-induced canopy contact (Class B Flight Mishap, RF-4C S/N 64-0997). The negative G strap may also be of benefit during other  $-G_z$  accelerations experienced operationally, such as those occurring during ejection.

The Tactical Air Command has recently issued a Statement of Operational Need (SON) for Advanced Aircrew Restraint System for Ejection Seat Equipped Tactical Aircraft. This SON, designated TAF 322-79, calls for improved restraint during sustained  $-G_z$  acceleration, out-of-control flight conditions, and emergency escape. Incorporation of a crotch strap into existing operational restraint systems may be the first step toward satisfying this need. In fact, negative G straps have recently been added to the restraint system in some T-38 aircraft.

As a result of this SON, the Life Support System Program Office of the Aeronautical Systems Division has established a Memorandum of Agreement with the Air Force Aerospace Medical Research Laboratory (AFAMRL) to investigate the feasibility and effectiveness of incorporating a crotch strap into the PCU-15/P torso harness and lap belt. The terms of the agreement specify that the evaluation will be comprehensive, including human experiments in both sustained and impact acceleration environments. If the results of this comprehensive evaluation show that the crotch strap improves crewmember protection, then the strap will be incorporated into the harnesses used in the ACES II ejection seats of the A-10, F-15, F-16, B-1B, and T-46A aircraft.

Evaluation of the potential benefits and risks associated with negative G strap incorporation has been hindered by the absence of adequate data bases. The ACES II ejection seat restraint system consists of a lap belt and the PCU-15/P integrated parachute harness and torso restraint. Although forward facing and vertical impact tests with volunteer subjects have been conducted using the PCU-15/P torso harness and lap belt (Brinkley & Shaffer, 1971; Baumann *et al.*, 1968), no tests have been conducted with a crotch strap incorporated into this restraint system. The F/FB-111 harness includes a crotch strap attached to the forward portion of the seat and this restraint harness has been extensively tested in all three cardinal axes (Brinkley *et al.*, 1981). However, the shoulder strap geometry of the F/FB-111 harness is not comparable to the PCU-15/P torso harness. Therefore, further impact tests of the PCU-15/P torso harness and lap belt restraint system were required to substantiate the benefits of incorporating a negative G strap attached to the forward portion of the seat into that restraint configuration.

A conventional double shoulder strap and lap belt restraint harness was used as the standard for comparison in this study. This harness had been previously used as a standard for comparison in 1980 during vertical impact tests to evaluate the F/FB-111 crew seat and restraint system. In that study (Brinkley *et al.*, 1982), statistically significant increases in the resultant lap belt load and seat loads were observed in the conventional harness compared to the F/FB-111 harness. It was theorized that these findings were due, at least in part, to the absence of a crotch strap in the conventional harness. In the present study, the results of human vertical impact tests in the conventional harness with an added negative G strap may improve understanding of those earlier findings.

## B. PROGRAM OBJECTIVES

The primary objective of this research effort was the comparative evaluation of human impact response in restraint systems with and without a negative G or crotch strap. Vertical impacts and forward facing impacts were performed in the PCU-15/P torso harness and lap belt and conventional double shoulder strap and lap belt configurations. The harnesses were tested with and without an added negative G strap.

There were also a number of secondary test program objectives. These included a comparison of human response in the PCU-15/P harness to such response in the conventional harness, clarification of previous vertical tests comparing the F/FB-111 harness to the conventional harness, and establishment of performance base line data that can be used to guide the development of new and improved restraint systems. Another purpose of this test program was to provide human impact response data for present and future mathematical modeling efforts, the goal of which is to predict human response to impact.

SECTION 2  
TECHNICAL APPROACH

A. EXPERIMENTAL DESIGN

The several null hypotheses evaluated in this study may be summarized as follows. First, human impact response in the PCU-15/P torso harness and lap belt is not significantly different from such response in the same PCU-15/P system with an added negative G strap. Second, human impact response in the conventional double shoulder strap and lap belt configuration is not significantly different from such response in the same conventional harness with an added negative G strap. Third, human impact response in the PCU-15/P torso harness and lap belt is not significantly different from such response in the conventional double shoulder strap and lap belt configuration. Fourth, human impact response in the PCU-15/P system with an added negative G strap is not significantly different from such response in the conventional restraint with an added crotch strap.

All four hypotheses were evaluated using both  $-G_x$  and  $+G_z$  impact tests. The forward facing or  $-G_x$  experiments were deemed operationally relevant due to the potential for submarining of the torso under the lap belt during, for example, aircraft crashes. These human impact tests were conducted on the AFAMRL Horizontal Impulse Accelerator (HIA). The experimental design matrix for this phase of the test program is shown in Table 1.

TABLE 1  
EXPERIMENTAL DESIGN MATRIX FOR HORIZONTAL TEST PHASE

RESTRAINT SYSTEM	NEGATIVE G STRAP	
	NO	YES
PCU-15/P	A	B
CONVENTIONAL	C	D

Vertical or  $+G_z$  impact tests were also deemed operationally relevant due to the potential for significant motion of the aircrew member relative to the seat during sustained  $-G_z$  maneuvers. These experiments were conducted on the AFAMRL Vertical Deceleration Tower (VDT). The experimental design matrix for this phase of the test program is shown in Table 2. Note that the matrix is identical to that shown in Table 1, but that different cell designations have been used in order to avoid confusion among the test conditions in the two phases of the program. The horizontal test phase preceded the vertical test phase. The four experimental level exposures in each test phase were randomized for each subject.

TABLE 2  
EXPERIMENTAL DESIGN MATRIX FOR VERTICAL TEST PHASE

RESTRAINT SYSTEM	NEGATIVE G STRAP	
	NO	YES
PCU-15/P	E	F
CONVENTIONAL	G	H

The controlled, independent variables in this study were the type of restraint harness, the presence or absence of the negative G strap, and the characteristics of the impact acceleration. To assure comparability among the test conditions in each phase of this program, the test facility operating parameters were held constant for each experimental level exposure. For example, the drop height of the impact carriage was held constant during the vertical test phase. (See also Section 2B.)

The impact acceleration profiles selected for use during this study were approximate half-sine waveforms which had been used in previous human impact test programs. In order to minimize the potential for injury to subjects, the tests were conducted at presumed subinjury impact levels. For the horizontal test phase, the 6 G peak (22 ft/sec) and the 8 G peak (26 ft/sec) impact levels were chosen as the orientation test levels and the experimental exposure level selected was 10 G peak (30 ft/sec). In the vertical test phase, the orientation exposure was 8 G peak (23 ft/sec) and the experimental exposures were performed at 10 G peak (26 ft/sec). In both phases, the forces acting on the subject at the experimental exposure level were generally sufficient to overcome the forces created by voluntary muscle contraction. A response suitable for comparative parametric analysis was, therefore, produced.

The sample of subjects participating in this test program was comparable to the USAF flying population in terms of age, sex, and anthropometry. The medical screening of all subjects prior to participation was more highly selective than a routine USAF Flying Class II evaluation. (See also Appendix A.) This resulted in a panel of supranormal volunteers, at least from a skeletal integrity standpoint. This difference in the populations of interest has a negligible influence on the significance of these test results, since all tests were conducted below the anticipated injury threshold, even for a normal population. A conservative approach to subject screening continues to be necessary to assure subject safety.

The observable, dependent variables which were measured during these experiments included the harness strap loads and the forces reacted at the seat, the triaxial translational acceleration components measured at the seat and at the subject's head and chest, and displacements of photometric targets placed on the subject. The accelerometers, load cells, strain gages, and other devices,

used to make these measurements are detailed in Appendix B. Significant unobservable variables during these experiments included the motion of each vertebral body and the force distribution along the vertebral column of the subject during the impact event.

## B. TEST CONFIGURATION

The test facility used for the horizontal test phase of this program was the AFAMRL Horizontal Impulse Accelerator (HIA). The HIA, which operates on the principle of differential gas pressure, is shown and briefly described in Appendix B. This test facility has been more thoroughly described elsewhere (Shaffer, 1976). In order to maintain constant impact test conditions, the chamber pressures of the HYGE actuator of the HIA were held constant. For all 10 G or experimental level impacts, the load chamber pressure was 173 psi, the trigger or thrust chamber pressure was 100 psi, and the set chamber pressure was 30 psi. Metering pin number 2 was used to control the flow of gas from the load chamber to the set chamber and thereby control the acceleration-time profile.

The test facility used for the vertical test phase of this program was the AFAMRL Vertical Deceleration Tower (VDT). The VDT is shown and briefly described in Appendix B. In order to assure nearly identical impact test conditions during this test phase, the same carriage plunger (number 102) was used and the carriage drop height was held constant. For all tests conducted at the 10 G or experimental test level, the carriage drop height was 11.0 ft.

The test fixture used for the horizontal test phase of this program was the "40 G" seat, shown in Figure 1. This generic seat and test fixture was designed to withstand 40 G impact accelerations and was fabricated by Production Design Services, Inc. Structural proof tests of the fixture to nearly 40 G have been accomplished. This generic seat was designed with standard operational ejection seat geometry. The seat back was reclined 130° from vertical and the seat pan was inclined up 60° from horizontal. The head contact plane of the headrest was located 1 inch aft of the seat back plane. The test fixture used in the vertical test phase of this program was a generic seat and test fixture produced by the Fabrication and Modification Division of the 4950th Test Wing. This test fixture, shown in Figure 2, permits a wide variety of seat and restraint harness adjustments. Adjustable features of the test fixture include the seat back angle and the locations of the headrest and restraint strap attachment points. In this phase of the test program, the 90° seat back angle position was selected for use. The seat pan plane was not inclined. The head contact plane of the headrest was 1 inch aft of the seat back plane, as per MIL-S-9479B.

The vertical headrest adjustment was held constant for each subject in each phase of this study. The required vertical headrest adjustment provided adequate head support, enabling the subject to brace his head against the headrest. Adequate head support was presumed to be present when the approximate Frankfort plane of the subject intersected the headrest. The Frankfort plane is defined by the lowest points in the inferior orbital rims and the midpoint of the line connecting the highest points in the margins of the auditory meati.



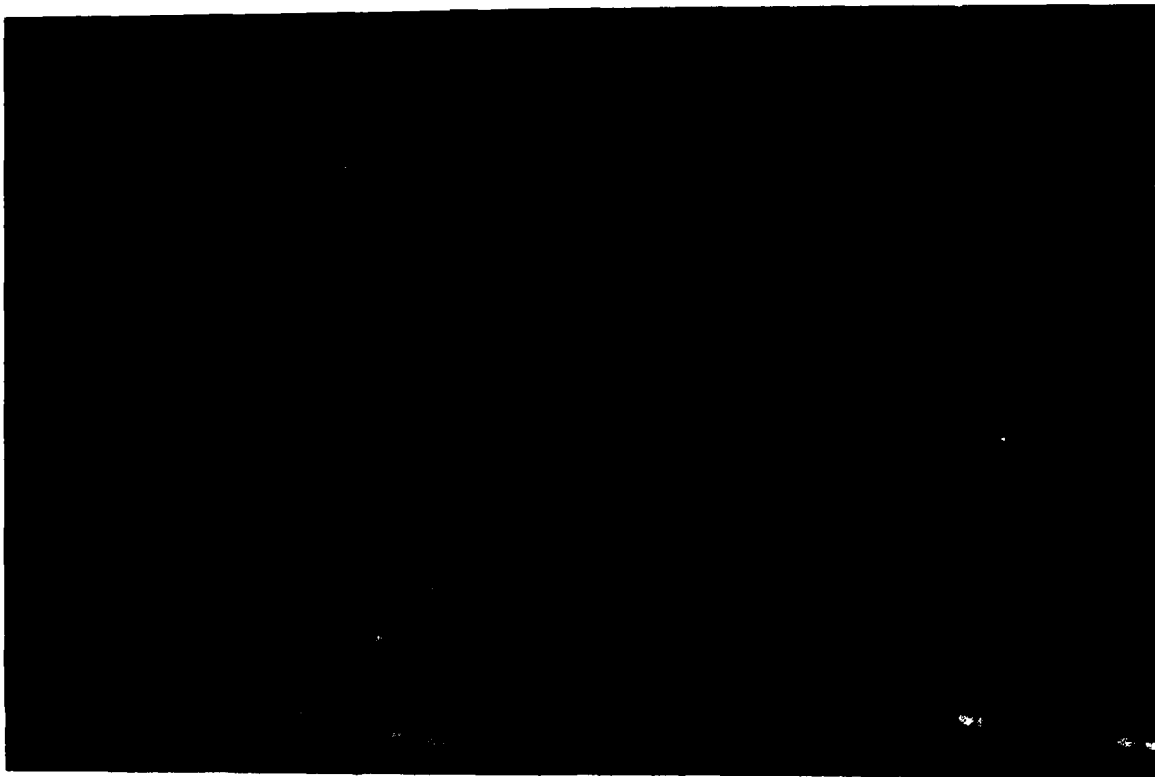


Figure 1. Test Fixture for Horizontal Test Phase.

Generic seats and test fixtures were selected for use during both phases of this study to allow broader applicability of test results. Use of a specific operational ejection seat in these tests may have limited applicability of the test results to that operational escape system.

Two restraint harnesses were used during this evaluation. The PCU-15/P torso/parachute harness (formerly known as the PCU-2/P) was used by most of the male subjects in the study (Figure 3). The smaller male subjects and the female subject used the smaller size PCU-16/P torso harness. The shoulder straps, attached to the parachute riser and restraint fittings (Koch part number 015-12231-3) of the PCU-15/P harness, consisted of 1 3/4 inches wide polyester Type I webbing (MIL-W-25361). The lap belt used with the PCU-15/P torso harness was an HBU configuration constructed of 1 3/4 inches wide polyester Type III webbing (MIL-W25361).

The second harness, which was used as a control or standard of comparison, was a conventional or standard USAF double shoulder strap and lap belt configuration (Figure 5). This conventional harness had also been used as a standard for comparison in other AFAMRL impact studies. The shoulder straps of this conventional restraint were an adjustable Type MB-6 harness constructed of 1 3/4 inches wide Type I polyester webbing and the lap belt was an HBU configuration constructed of 1 3/4 inches wide Type XIII nylon webbing (MIL-W-4088H).

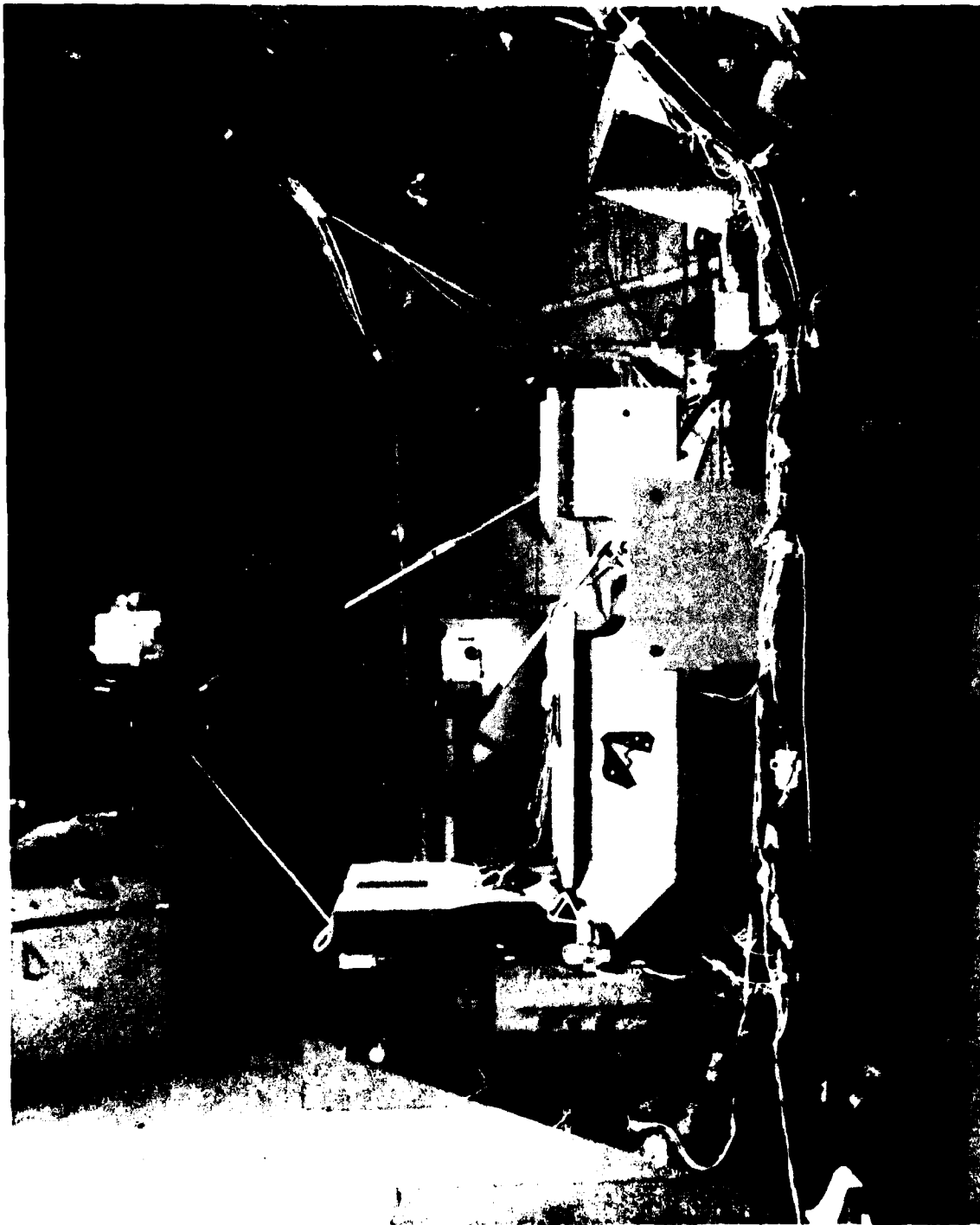


Figure 2. Test Fixture for Vertical Test Phase.

The lap belt of either harness, of course, was anchored at two locations. However, the shoulder straps were anchored at a single location on the aft bulkhead of the test fixture. Triaxial loads were measured at these three harness attachment points.

The negative G strap (USAF Part No. 45402-0101649-01), added to the restraint harnesses in some test conditions (see Figures 4 and 6), consisted of 1 3/4 inches wide polyester Type I webbing. In order to accommodate the added negative G strap, a modified Type MA-1 harness buckle was used with each lap belt during all tests in this series. The negative G strap was anchored at a point 15 inches forward of the seat reference axis in all tests. This position corresponds to the distance from the seat reference axis to the center of the forward edge of the ACES II survival kit lid and is consistent with accepted guidance (Desjardins & Laananen, 1980). During the horizontal test phase, the vertical location of this anchor point was 1/8 inch below the X axis (see Figure B-7). During the vertical test phase, the vertical location of the negative G strap anchor point was 6/10 inch below the X axis (see Figure B-8).

Before impact tests were conducted in either test phase, the length of the negative G strap used was selected in a static evaluation of several negative G straps of different lengths. Subjects representative of the range of subject anthropometry in this study participated in the static evaluation. The negative G strap selected for use in each test phase best fulfilled the intended purpose of the strap, i.e., tethering the lap belt to the forward portion of the seat. During the horizontal test phase, the negative G strap was 10 inches in length. During the vertical test phase, the negative G strap was 8 5/8 inches in length. The difference in these required lengths was due primarily to the fact that the seat pan was inclined up 6° from horizontal during the horizontal test phase, whereas the seat pan was not inclined upward during the vertical test phase.

The four basic restraint configurations investigated in this study are shown in Figures 3 through 6. As previously noted, each restraint configuration was evaluated in both  $-G_x$  and  $+G_z$  impact tests.

The conduct of each human impact test was the responsibility of a qualified and experienced test conductor. The test conductor assured that the appropriate equipment, facility, and subject preparations were accomplished prior to each test by means of a pre-established checklist. Each subject was properly fitted with the PCU-15/P (or PCU-16/P) torso/parachute harness. In particular, the leg straps were adjusted in accordance with the harness technical order, so that, when properly adjusted, the subject could not assume a fully upright standing position. After the subject was seated on the test fixture, the lap belt and shoulder straps were pretensioned to 20 + 5 lb, measured by load cells at the three attachment fittings. The negative G strap was a fixed length; its pretension could not be adjusted. Instrumentation of the test fixture and restraint harness is more thoroughly described in Appendix B.

Subjects were instructed to assume the same pre-impact body position prior to each test in this series. Subjects were asked to keep head back against the headrest and to maintain a mild to moderate amount of posterior cervical muscle tension. They were instructed not to brace upper extremities against the lower extremities or the seat. Subject preparations and accelerometer instrumentation of subjects are more completely described in Appendix A. After delivering final instructions to the subject, the test conductor initiated the appropriate count-down procedures for the test facility and the impact test was accomplished.

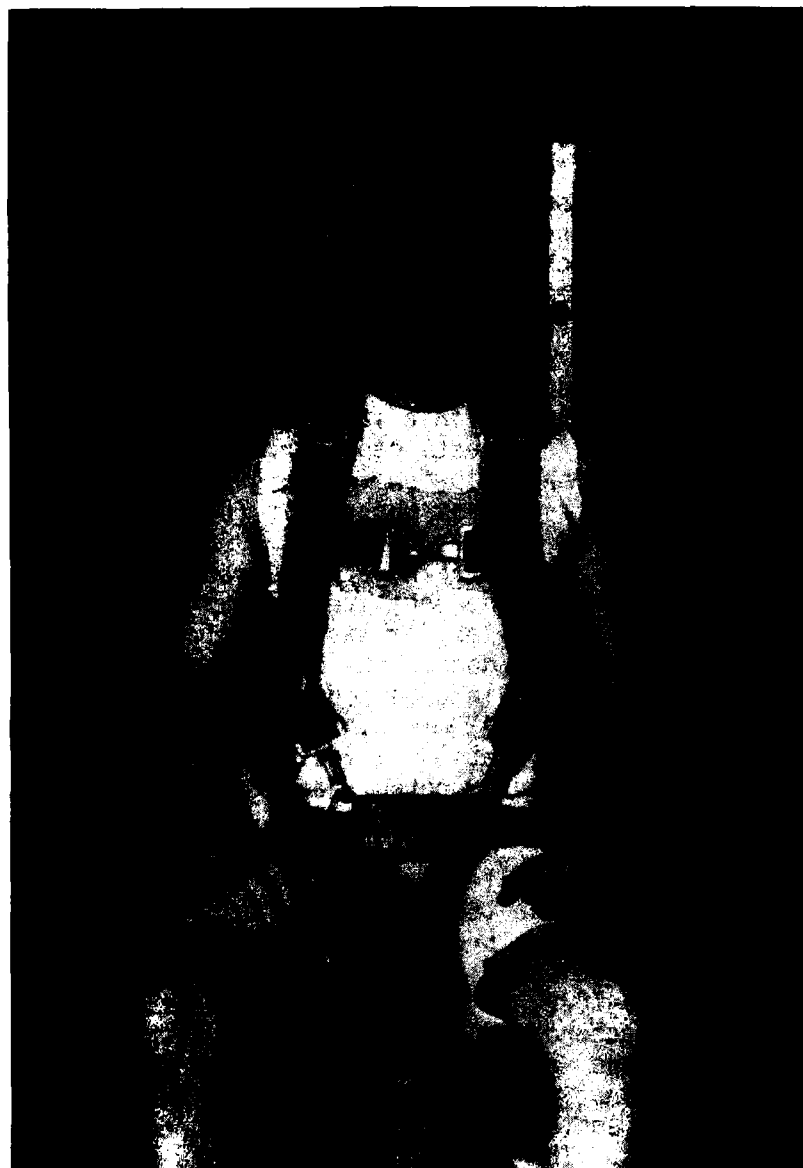


Figure 3. PCU-15/P Torso Harness and Lap Belt Configuration  
Used in Test Conditions C and G

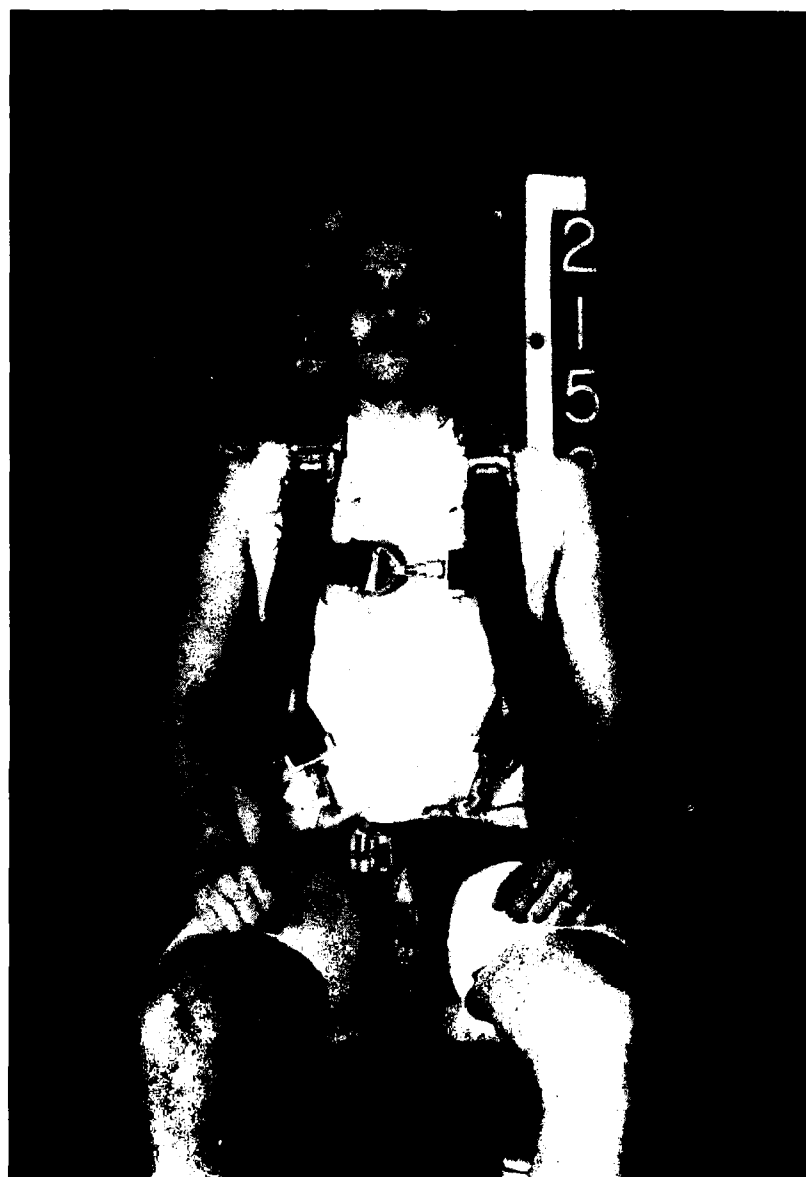


Figure 4. PCU-15/P Torso Harness and Lap Belt Configuration with an Added Negative G Strap Used in Test Conditions D and H



Figure 5. Conventional Double Shoulder Strap and Lap Belt Configuration Used in Test Conditions A and E

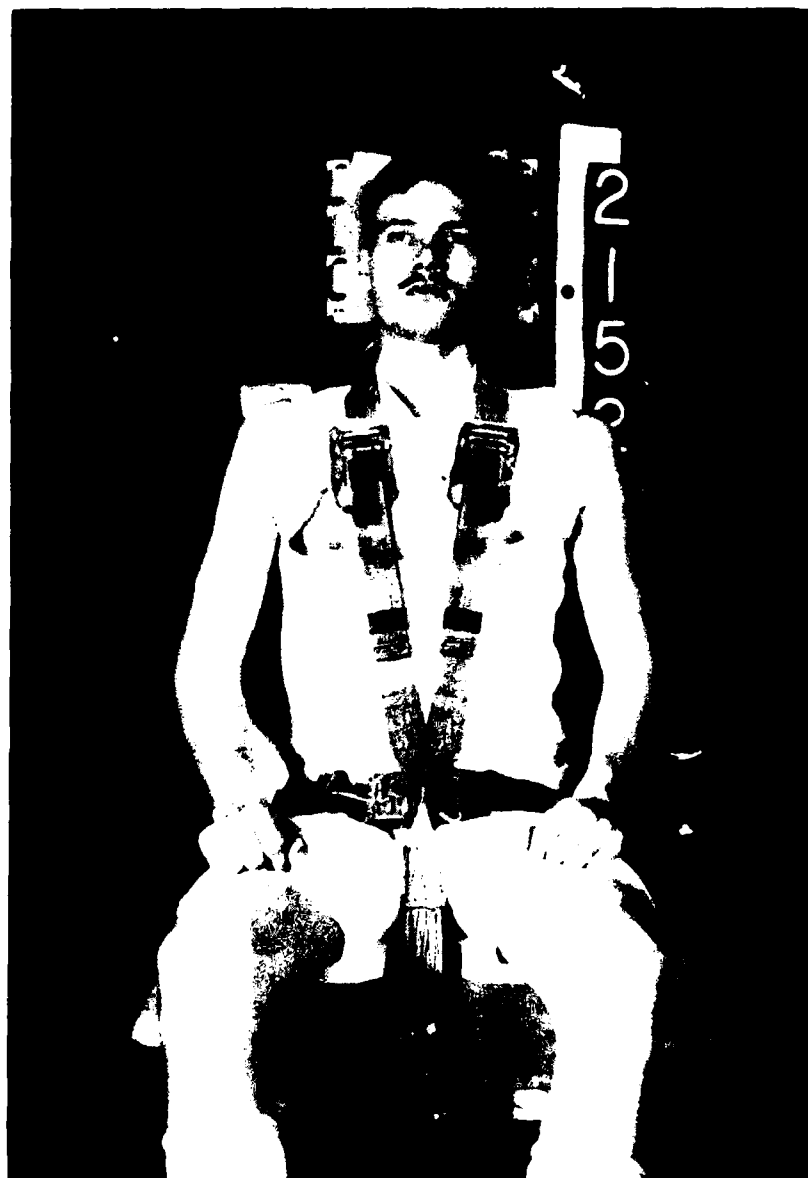


Figure 6. Conventional Double Shoulder Strap and Lap Belt Configuration with an Added Negative G Strap Used in Test Conditions B and F

### C. EVALUATION CRITERIA

Numerous electronic measurements were obtained during these experiments. These measurements included acceleration of the test sled (or carriage), acceleration of the test seat, and velocity change of the test sled (or carriage). Review of these parameters permitted an assessment of how well the impact test conditions were being controlled. The electronic data also included loads measured at the seat; tensions at the shoulder strap, lap belt and negative G strap attachment fittings; and accelerations measured at the subject's head and chest. Review of these parameters permitted assessment of subject impact response. All electronic data were recorded as a function of time. The Automatic Data Acquisition and Control System (ADACS) acquired data at a rate of 1,000 samples/second.

The accelerometer packages used in this study consisted of translational accelerometers made by Endevco and arranged in triaxial arrays (see Appendix B). The nature of these accelerometers must be borne in mind when interpreting the data obtained, particularly the head acceleration data. The mouth accelerometer array measures translational acceleration with respect to a rotating coordinate frame when there is rotation of the subject's head. In the vertical impact tests, for example, when the angular position of the head changes as a result of forward and downward head rotation, a portion of the head acceleration parallel to the tower rails is measured as  $-X$  acceleration by the rotated accelerometer package. Similarly, if the head rotates rearward, a portion of the head acceleration parallel to the tower rails can be seen as  $+X$  acceleration. However, when the angular position of the head does not change during vertical impact, forward head acceleration perpendicular to the tower rails is also measured as  $+X$  acceleration.

During forward facing or  $-G_x$  impacts, the angular position of the head changes rapidly as the head moves forward and rotates downward. In this situation, a portion of the head acceleration parallel to the tracks of the horizontal impact test facility is measured as  $-Z$  head acceleration by the rotated mouth accelerometer package. Also, the rapid change in the angular position of the head undoubtedly produces centripetal acceleration, which is seen as  $-X$  or  $-Z$  axis head acceleration. In both  $+G_z$  and  $-G_x$  tests, the measured head acceleration during the impact is influenced by the initial angular position of the head and the associated initial angular position of the mouth accelerometer array.

All electronic test data were processed by computer to determine the maximum and the minimum values of each data channel which occurred during impact. For the vertical tests, the maximum value occurring during the free fall period was also obtained for all load data channels. For the horizontal tests, the immediate pre-impact average was calculated for all load data channels. This value was obtained by computing the arithmetic average of the data for 25 msec prior to the impact. The data plots and the tabulated maxima and minima for each test were then carefully reviewed for inconsistencies or artifacts. For example, in some  $-G_x$  tests, subject headstrikes against the headrest during the impact rebound phase of the experiment may produce relatively large  $+X$  head accelerations. These rebound head accelerations are often larger than the peak head accelerations occurring during the initial impact response. To preclude inappropriate comparison of rebound maxima to true impact maxima, the data file must be modified by replacing the rebound maximum with the actual impact maximum for that test. Such data file modifications were required in this program (see Section 4C).



Evaluation of the entire measured acceleration-time histories of head and chest was accomplished by calculating Severity Indices (Gadd, 1966). These single parameters, which were derived by a weighted integral of the acceleration-time function taken over the interval of the impact ( $SI = \int a^n(t)dt$ , where  $n = 2.5$ ), were used to compare the severities of subject impact responses. No exposure limit values, however, were assigned to the head or chest acceleration Severity Indices. These values were used in a relative sense only for purposes of comparison.

The Wilcoxon paired-replicate rank test (Wilcoxon & Wilcox, 1964) was the statistical technique used to compare the maxima and minima of the electronically measured and computed parameters and to establish the statistical significance of observed trends in the data. This nonparametric test permits the formulation and evaluation of null hypotheses when evaluating two sets of paired measurements. The test is based on the premise that any chance differences between two sets of paired measurements derived from populations which are not significantly different should consist of approximately equal numbers of positive and negative differences. The Wilcoxon technique considers not only the direction of these arithmetic differences, but also the size of the differences between the matched pairs. In the evaluation of the electronic data, the 95% confidence level was chosen as the level of statistical significance for rejection of the null hypothesis, assuming a two-tailed test. In order to quantify observed statistically significant differences, the parameter means and the percentage change in those parameter means were calculated. The Wilcoxon paired-replicate rank test is more thoroughly described in Appendix D.

All acceleration data were referenced to a zero or one G base line, established in the instrumentation prior to each test. For tests conducted on the HIA, the test sled was at rest prior to the impact. Therefore, the X axis and Y axis accelerations measured before the impact were essentially zero and the Z axis acceleration was one G. For tests conducted on the VDT, the test carriage was in a free fall condition immediately prior to the impact. In this condition, the fixture-mounted and subject-mounted accelerometers registered nearly zero in the Z axis, with negligible accelerations in the other cardinal axes. Therefore, the pre-impact variations in the measured acceleration data were negligible in both test phases.

However, pre-impact variations in the measured strap loads and seat loads were less well-behaved. The variations in these measured values were due to differences in harness pretension, subject position, and subject muscle tension, despite efforts to assure these were nearly equivalent for a given subject from test to test. In some cases, relatively large variations in the pre-impact values of these parameters were observed among comparable test conditions. To minimize the influence of these variations on data analysis, an appropriate pre-impact value was subtracted from the impact maximum and minimum values. The resulting difference was presumably more reflective of the change in the parameter due to the impact than the measured impact maximum or impact minimum value. The Wilcoxon analysis was then performed on the resulting differences between measured impact and measured pre-impact values. For the  $-G_x$  tests, immediate pre-impact loads were calculated by averaging the measured values over the 25 msec interval immediately preceding the impact. For  $+G_z$  tests, the free fall maximum value was obtained for the involved parameters and was used as the pre-impact base line.

Photometric data were obtained during this test program by two high-speed (500 frames/sec) Milliken cameras mounted on the test fixtures. During the horizontal test phase, an oblique view and a left lateral view of the impact were obtained; during the vertical test phase, an oblique view and a right lateral view of the impact were obtained. The lateral data from the horizontal test phase were used to assess subject impact response, particularly the tendency toward subject submarining. This was achieved by quantifying subject knee displacement (horizontal, vertical, and resultant) as a result of the impact. The displacement data were analyzed by means of the Wilcoxon paired-replicate rank test. For these data, the more liberal 90% confidence level was chosen as the level of statistical significance for rejection of the null hypothesis, assuming a two-tailed test, since the variance of the photometric data is greater than the variance of the electronic data.

The evaluation criteria for this study were based on the fundamental principles of biomechanical protection. In general, injuries resulting from impact accelerations are due to differential acceleration of body segments or parts and excessive internal structural loading. In particular, for  $+G_z$  impacts, human tolerance appears to be limited by vertebral compression fracture. Therefore, it is most important during vertical impact tests to minimize vertical and resultant seat loads, since these loads indirectly reflect axial loading of the vertebral column. Of secondary importance during vertical impacts, is that body segment (head and chest) accelerations be minimized. This is true because the accelerative forces acting on these body segments may produce bending and, therefore, reduce the load bearing capability of the vertebral column.

The mechanism of injury limiting human tolerance to  $-G_x$  impacts is less clear. Medical adverse effects to such impacts include cardiovascular, neurologic, and musculoskeletal sequelae. Relative bradycardia has been reported following 15 G peak, 20 ft/sec impacts (Rhein & Taylor, 1962). This effect was believed to be vagal-mediated, since it could be blocked by the pre-impact administration of atropine (Taylor et al., 1962). Intraventricular conduction defects in the form of bundle branch blocks have been noted following forward facing impacts at 11.3 G peak, 46.5 ft/sec (Majewski et al., 1978). These isolated cardiac conduction disturbances were transient in nature and required no treatment. Signs of cardiovascular shock, including pallor, diaphoresis, hypotension, and tachycardia, have been noted following  $-G_x$  impacts at very high exposure levels (Stapp, 1951). To produce these symptoms, impact accelerations exceeding 30 G peak with onset rates exceeding 1000 G/sec were required. Subjects experiencing cardiovascular shock symptoms were temporarily incapacitated, but vital signs rapidly improved with recumbency.

Temporarily incapacitating neurologic disturbances have been observed following experimental and operational forward facing impacts. Transient visual disturbances have been reported for  $-G_x$  impacts above 35 G by Stapp (1951) and Beeding (1960, 1961). Reader (1979) has reported inappropriate crewmember behavior resulting from presumed concussion during aircraft crashes. Post-mortem examination of fatally injured crewmembers failing to egress such downed aircraft in a timely fashion revealed no evidence of external trauma to the head. Therefore, the head acceleration experienced during the whole body impact may have alone been responsible for the observed behavior. However, in a laboratory setting, even the behavioral disturbances observed operationally presumably would have been transient and reversible.

Musculoskeletal trauma, in the form of vertebral compression fractures, have been observed after  $-G_x$  human impact experiments. One fracture occurred at a peak acceleration below 20 G, but with a relatively high velocity change of 57 ft/sec (Lovelace et al., 1945). Other vertebral fractures have been observed at peak accelerations in excess of 30 G with G onset rates in excess of 1000 G/sec (Beeding, 1960). Although no neurologic sequelae have been reported as a result of such fractures, the injuries are nevertheless considered to be irreversible.

It may, therefore, be argued that vertebral compression fracture, by its nature an irreversible injury, limits  $-G_x$  impact tolerance as well as  $+G_z$  tolerance. This may be true in spite of the reversible cardiovascular and neurologic effects observed at lower peak acceleration levels. Therefore, during forward facing impact tests, minimizing seat loads, which are generally reflective of vertebral loading, appears to be warranted. However, probably equal in importance is the goal of minimizing body segment accelerations, particularly head accelerations, in view of the transient but potentially incapacitating neurologic consequences of excessive head acceleration during  $-G_x$  impacts.

Since it is not ethically or morally possible to conduct laboratory impact experiments with human subjects at operational exposure levels associated with a significant probability of serious injury, the tests in this series were performed at exposure levels associated with an acceptably low risk of injury. The test results, therefore, cannot be extrapolated to operational impact acceleration levels for the purpose of predicting injury rates. However, the statistically significant trends established at the experimental levels should be valid with increasing levels of impact acceleration approaching the operational range until the nonlinearities associated with injury are encountered.

## SECTION 3

### TEST RESULTS AND ANALYSIS

#### A. OVERVIEW

The electronically measured and computed data obtained during both phases of this test program are presented in Appendix C. This Appendix contains tabular data which summarize the results of each test conducted at the experimental level. The data presented include the impact maximum and impact minimum values of each data channel and the corresponding times at which these values occurred. In addition, from the load data channels, the pre-impact average loads are shown for the horizontal tests and the maximum loads occurring during free fall are shown for the vertical tests. Tabular data summarizing the means and estimated standard deviations of pertinent response parameters from each cell of the experimental matrices are also presented in Appendix C. Horizontal test phase data are summarized in Table C-1 and vertical test phase data are summarized in Table C-2. Finally, a typical set of graphic data from each of the eight test conditions (A through H) is also included in Appendix C.

Statistical analyses of these electronic data by the Wilcoxon paired-replicate rank test were accomplished. Eight comparisons of paired response parameters were performed. The results are presented in Appendix D. The Wilcoxon analysis for each statistically significant trend in these comparisons is also shown. Accompanying each of these computations is the percentage increase in the parameter mean and the confidence level at which the statistically significant trend may be reported. Appendix D also contains tabular data summarizing all results of each Wilcoxon comparison. Tables D-1 to D-4 list the results from the horizontal test phase and Tables D-5 to D-8 show the results from the vertical test phase. These tables provide the means and estimated standard deviations of pertinent response parameters and also indicate the presence or absence of a statistically significant trend at the 95% confidence level for a two-tailed test.

In each test phase, control of the impact test conditions was essential to assure comparability among the experimental level exposures. For the horizontal test phase, peak accelerations measured at the sled and the seat as well as sled velocity change during the impact were assessed by the Wilcoxon technique. These impact test conditions were well controlled. Variations which occurred would not be expected to produce systematic error, as evidenced by the absence of statistically significant trends among these measured parameters.

For the vertical test phase, peak accelerations measured at the carriage and the seat as well as carriage velocity change during the impact were assessed by means of the Wilcoxon technique. These impact test conditions were also reasonably well controlled. However, systematic differences between test conditions did occur in some cases, resulting in small but statistically significant differences in these measured parameters. These small differences in impact test conditions presumably did not appreciably influence other measured response parameters. This is discussed further in Section 3C.

Two noteworthy modifications to the electronic data file were made prior to data processing. First, tare loads of the seat were subtracted from the measured seat loads. In the horizontal test phase, the product of the seat pan mass and the instantaneous X axis seat acceleration was subtracted from the instantaneous horizontal seat load. In the vertical test phase, the product of the seat pan mass and the instantaneous Z axis seat acceleration was subtracted from the instantaneous vertical seat load. Problems encountered with the tare load correction in the horizontal test phase are described in Section 4C.

Second, the effects of headstrikes and other artifacts were considered. In several  $-G_x$  experiments, the subject's head contacted the headrest during the rebound phase of the impact. Such head-headrest contact, confirmed by review of the photometric data, resulted in relatively large  $+X$  head accelerations. In these cases, the data file was corrected to assure that the maximum X axis head acceleration recorded in the data file was that which actually occurred during the initial phase of the impact, rather than during the rebound phase.

Photometric data were obtained during both phases of this study. The photometric data acquisition system is described in Appendix B. The techniques used in photometric data processing and analysis are described in Appendix E. Analysis was limited to data from the horizontal test phase and was based on the assumption that subject motion would be primarily in the X-Z plane. Pertinent subject displacement data were obtained by tracking subject-mounted fiducials at the head and knee. The knee displacement data were used to assess subject submarining during  $-G_x$  tests. The available displacement data from the horizontal test phase are summarized in Table E-1 in Appendix E. This Appendix also contains the Wilcoxon analyses of these data.

The test results derived from this study are summarized in the next four subsections of this report. Electronic and photometric data from the horizontal test phase are summarized in Section 3B. Electronically measured and computed data from the vertical test phase are summarized in Section 3C. The medical data from both phases of the experiment are presented in Section 3D. Finally, the subjective data, obtained from post-test questionnaires administered to the participants, are presented in Section 3E.

## B. HORIZONTAL TEST PHASE: ELECTRONIC AND PHOTOMETRIC DATA

The electronic and photometric data obtained during the horizontal test phase are summarized in Tables 3 through 6. In the first two tables, the effects of adding a negative G strap are presented and, in the last two tables, the restraint harness effects are presented. These results of Wilcoxon comparisons are expressed in terms of percentage and magnitude increases in parameter means.

The key response parameters evaluated during this test phase were knee displacement, head displacement and acceleration, and vertical seat load. Knee displacement during impact was quantified to permit assessment of torso submarining beneath the lap belt and of negative G strap efficacy in preventing this motion. Larger knee displacements were presumed to be associated with a greater likelihood of submarining.

As previously noted in Section 2C, body segment displacements and accelerations, particularly head displacement and acceleration, must be minimized during  $-G_x$  impacts in order to reduce the risk of neurologic sequelae. To minimize the risk of vertebral fracture, vertical seat load must also be minimized. Accordingly, statistically significant increases in head displacement, head acceleration, or vertical seat load were presumed to be associated with a more severe impact response. Furthermore, trends among these response parameters were presumed to be equal in importance.

In comparison A-B, the effects of incorporating a negative G strap into the PCU-15/P torso harness and lap belt arrangement were assessed. The electronic data from that comparison are summarized in Table 3 and the photometric data are summarized in Table 4.

Vertical and resultant head displacements were higher by 20% (1.12 inches) and by 12% (1.12 inches), respectively, without the negative G strap. However, these findings were not accompanied by similar increases in component or resultant head accelerations.

The total shoulder strap load averaged 5% (33 lb) higher in the PCU-15/P torso harness configuration when the negative G strap was added to the lap belt. This finding, presumably due to the X component of the shoulder strap load, suggests an increased forward inertial response of the upper torso with the added negative G strap. There was a corresponding tendency for larger  $-X$  axis chest acceleration with the negative G strap, but the trend was not statistically significant.

An 8% (150 lb) increase in the total lap belt load was noted with the added negative G strap (Table 3). Also, the knee displacement data (Table 4) revealed relatively small but statistically significant increases in vertical and resultant knee displacements without the negative G strap. The negative G strap and lap belt combination, therefore, apparently provides more effective pelvic restraint than the lap belt alone.

Thus, incorporation of the negative G strap into the PCU-15/P torso harness and lap belt configuration effectively reduces the tendency toward submarining during  $-G_x$  impacts. More effective pelvic restraint is provided, but lap belt and shoulder strap loads are somewhat increased. However, negative G strap inclusion does not significantly alter the critical response parameters, such as body segment accelerations, associated Severity Indices, or vertical seat load. Therefore, negative G strap incorporation into the PCU-15/P torso harness and lap belt improves  $-G_x$  impact protection.

In comparison C-D, the effects of incorporating a negative G strap into the conventional double shoulder strap and lap belt harness configuration were considered. The electronic data from this Wilcoxon comparison are summarized in Table 3 and the photometric data are summarized in Table 4.

The mean total shoulder strap load was 17% (107 lb) higher during impact in the configuration with the added negative G strap. The increase in total shoulder strap load with the negative G strap seen in this comparison was greater in magnitude than the similar increase seen in the A-B comparison. This finding is consistent with the interpretation that the negative G strap, when incorporated into the conventional harness, provides a direct pathway from the shoulder

straps to the seat (Figure 6). This conclusion is also supported by the findings that  $-X$  chest acceleration was 25% (3.2 G) higher and the chest Severity Index was 15% higher during impact in the configuration with the added negative G strap.

In comparison C-D, there was a 10% (170 lb) increase in total lap belt load in the configuration with the negative G strap. This may be indicative of an increased forward inertial response of the pelvis against the lap belt, suggesting that the lap belt is providing better pelvic restraint with the added negative G strap. On the other hand, the negative G strap tension may simply influence lap belt tension directly.

The most disturbing finding is that the vertical seat load was 14% (190 lb) higher with the added negative G strap. This could indicate that greater vertebral loading may be anticipated when subjects are exposed to  $-G_x$  impacts in a conventional harness with an added negative G strap. If so, subjects would approach the threshold for vertebral fracture at lower impact levels with the crotch strap than without it. Alternatively, this finding may simply represent the negative G strap tension reacted through the pelvis by the seat. The relative contributions of these two potential effects is impossible to determine from these data, but the second effect is believed to predominate, purely from geometrical considerations. Fortunately, the latter effect is also the most benign.

Analysis of the photometric data revealed statistically significant increases in horizontal, vertical, and resultant knee displacements without the negative G strap. For example, the resultant knee displacement was 20% (1.58 inches) greater without the negative G strap. Since the magnitude of the increase in resultant knee displacement without the negative G strap was greater in the C-D comparison than in the A-B comparison, the negative G strap is apparently more effective in decreasing the tendency toward submarining in the conventional harness than in the PCU-15/P torso harness and lap belt configuration. This difference in the efficacy of the negative G strap in the two restraint systems is attributable to the fundamental differences in restraint geometry.

In the C-D comparison, there were no statistically significant differences in head displacement or acceleration.

In summary, incorporation of a negative G strap into a conventional double shoulder strap and lap belt configuration produces a clearly beneficial effect on  $-G_x$  impact response. The direct load pathway from the shoulder straps to the seat via the negative G strap provides very effective pelvic restraint, more so than in the PCU-15/P harness. As evidenced by the effective limitation of knee displacement, the negative G strap fulfills its intended purpose of decreasing the tendency toward submarining during forward facing impact. The risk of internal injury associated with submarining is, therefore, limited.

However, the presence of the negative G strap in the conventional configuration also produces increased vertical seat load. This finding probably is the result of negative G strap and lap belt tensions being reacted through the pelvis by the seat. Alternatively, the increased seat load may be due to an increased downward inertial response of the torso and thus be indicative of increased vertebral column loading. In either case, any increased injury potential associated with this finding is most likely outweighed by the decreased injury potential associated with limiting the tendency toward submarining.

TABLE 3

HORIZONTAL TEST PHASE ELECTRONIC DATA:  
NEGATIVE G STRAP EFFECTS

(Wilcoxon Comparisons A-B and C-D)  
Negative G Strap Absent in Test Conditions A and C  
Negative G Strap Present in Test Conditions B and D

MEASURED PARAMETER	INCREASE IN PARAMETER MEAN		NEGATIVE G STRAP CONDITION FOR WHICH THE PARAMETER MEAN WAS LARGER
	PCU-15/P A - B	CONVENTIONAL C - D	
	(N = 14)	(N = 18)	
SLED ACCELERATION	NSD	NSD	
SLED VELOCITY	NSD	NSD	
SEAT ACCELERATION	NSD	NSD	
CHEST ACCELERATION			
-X Axis	NSD	25% (3.2 G)	Present
+Z Axis	NSD	NSD	
Resultant	NSD	NSD	
CHEST SEVERITY INDEX	NSD	15% (5.5)	Present
HEAD ACCELERATION			
-X Axis	NSD	NSD	
-Z Axis	NSD	NSD	
Resultant	NSD	NSD	
HEAD SEVERITY INDEX	NSD	NSD	
STRAP LOADS			
Total Shoulder Straps	5% (33 lb)	17% (107 lb)	Present
Total Lap Belt	8% (150 lb)	10% (170 lb)	Present
VERTICAL SEAT LOAD	NSD	14% (190 lb)	Present

This table summarizes the pertinent results of two comparisons by means of the Wilcoxon paired-replicate rank test. Statistically significant differences in response parameters are indicated in terms of percentage and magnitude increases in parameter means ( $2\alpha \leq 0.05$ ). NSD indicates no statistically significant difference in the response parameter in that comparison.



TABLE 4  
HORIZONTAL TEST PHASE PHOTOMETRIC DATA:  
NEGATIVE G STRAP EFFECTS  
(Wilcoxon Comparisons A-B and C-D)  
Negative G Strap Absent in Test Conditions A and C  
Negative G Strap Present in Test Conditions B and D

MEASURED PARAMETER	INCREASE IN PARAMETER MEAN		NEGATIVE G STRAP CONDITION FOR WHICH THE PARAMETER MEAN WAS LARGER
	PCU-15/P A - B	CONVENTIONAL C - D	
	(N = 10)	(N = 15)	
HEAD DISPLACEMENT			
Horizontal	NSD	NSD	
Vertical	20% (1.12 in)	NSD	Absent
Resultant	12% (1.12 in)	NSD	Absent
KNEE DISPLACEMENT			
Horizontal	NSD	16% (0.61 in)	Absent
Vertical	10% (0.89 in)	21% (1.65 in)	Absent
Resultant	11% (0.94 in)	20% (1.58 in)	Absent

This table summarizes the pertinent results of two comparisons by means of the Wilcoxon paired-replicate rank test. Statistically significant differences in response parameters are indicated in terms of percentage and magnitude increases in parameter means ( $2\alpha \leq 0.05$ ). NSD indicates no statistically significant difference in the response parameter in that comparison.

In comparison A-C, the effects of differences between the two restraint configurations were examined. In these test conditions, neither harness incorporated a negative G strap. Comparison results of the electronically measured and computed data by means of the Wilcoxon technique are presented in Table 5. Comparison results of the photometric data are presented in Table 6.

In this comparison, the component and resultant head displacements were higher, on the average, by 12% in the PCU-15/P torso and lap belt configuration compared to the conventional harness. Also, there was an associated increase by 26% (2.4 G) in -Z head acceleration in the PCU-15/P harness. These findings indicate less adequate impact protection in the PCU-15/P harness than in the conventional harness.

There were statistically significant increases in component and resultant chest accelerations as well as in chest Severity Index in the PCU-15/P harness. In terms of percentage, these increases were relatively large. Notably, there was a 75% (28.4) increase in chest Severity Index when the PCU-15/P harness was used. These findings are consistent with the photometric data which revealed considerable displacement of the upper torso away from the seat back during -G<sub>x</sub> impacts of subjects wearing the PCU-15/P harness. The upper torso, therefore, is not well supported during fore-aft impacts in this restraint system, relative to the conventional harness.

Statistically significant increases in the total shoulder strap load and total lap belt load were also seen in the PCU-15/P harness. These increases were 11% (66 lb) and 14% (230 lb), respectively. These findings are indicative of increased forward inertial response of the upper torso and pelvis, respectively.

The 15% increase in horizontal knee displacement in the PCU-15/P harness suggests a greater tendency toward submarining in that harness than in the conventional harness. Also, the vertical seat load was increased by 10% (140 lb) in the PCU-15/P harness compared to the conventional harness. This finding indicates greater axial vertebral loading and thus less adequate impact protection in the PCU-15/P harness.

In summary, these findings indicate that the PCU-15/P torso harness and lap belt configuration is inferior to the conventional double shoulder strap and lap belt configuration in terms of providing -G<sub>x</sub> impact protection. This result is not unexpected, since the PCU-15/P system was designed to function as a parachute harness and then, by attachment of shoulder straps and an independent lap belt, was given an additional role as a restraint system.

Finally, in comparison B-D, the effects of differences between the two restraint configurations with added negative G straps were examined. Wilcoxon comparison results of the electronic data are presented in Table 5 and results of the photometric data are presented in Table 6.

Component and resultant chest accelerations and chest Severity Index were higher in the PCU-15/P harness with an added negative G strap compared to the conventional harness with an added negative G strap. For example, there was a 51% (8.9 G) increase in resultant chest acceleration in the PCU-15/P configuration compared to the conventional configuration. These findings, of course, indicate less adequate impact protection in the PCU-15/P torso harness and lap belt with an added negative G strap than in the other configuration.

Total lap belt load was increased by 12% (220 lb) in the PCU-15/P configuration compared to the conventional configuration. In addition, horizontal, vertical, and resultant knee displacements were increased in the PCU-15/P configuration, suggesting a greater tendency toward submarining of the torso beneath the lap belt. As expected, the negative G strap in the conventional harness carried significantly greater load (by 56% or 76 lb) than the negative G strap in the PCU-15/P configuration. This is due to the direct load pathway from the shoulder straps to the seat created by the negative G strap in the conventional harness.

Notably, there were no statistically significant trends among the head displacement, head acceleration, and vertical seat load data. Despite the absence of trends among these critical response parameters, it may be concluded that the PCU-15/P configuration with an added negative G strap provides less adequate  $-G_x$  impact protection than the conventional configuration with an added negative G strap. This conclusion is based on the statistically significant trends in the chest acceleration and knee displacement data.

In summary, then, the results of comparisons B-D and A-C taken together indicate that the conventional harness provides superior  $-G_x$  impact protection compared to the PCU-15/P configuration, regardless of the negative G strap. However, more careful study of the differences between the results of comparisons B-D and A-C provides additional insights into the effects of negative G strap incorporation. One would expect to observe similar statistically significant trends in comparisons B-D and A-C, if the restraint-occupant dynamics of both configurations were influenced by negative G strap incorporation in essentially the same manner. However, this is not the case.

Although similar trends are observed among the chest acceleration data in both comparisons, different trends are observed among other response parameters. For example, the statistically significant trend in  $-Z$  head acceleration in comparison A-C is absent in comparison B-D. The same is also true for trends in component and resultant head displacements and vertical seat load. In each case, the statistically significant trend in the A-C comparison, indicating less adequate impact protection in the PCU-15/P configuration, was absent in the B-D comparison. Therefore, the differences in these critical response parameters between the PCU-15/P and conventional configurations are apparently minimized by negative G strap incorporation. In other words, the  $-G_x$  impact protection performance of the two configurations are more nearly equivalent with negative G straps than without negative G straps. Stated still another way, the overall effect of negative G strap incorporation is a greater improvement in  $-G_x$  impact protection for the PCU-15/P system than for the conventional configuration. These conclusions are also supported by the results of comparisons A-B and C-D.

The absence of a statistically significant difference in vertical seat load in comparison B-D is noteworthy. Although the addition of a negative G strap to the conventional harness increases the vertical seat load (comparison C-D), the vertical loads were not, on the average, greater than the vertical loads measured in the PCU-15/P harness configuration with a negative G strap. This may be further substantiation of the direct role of the negative G strap in loading the seat through the pelvis rather than through increased axial vertebral loads.

TABLE 5

HORIZONTAL TEST PHASE ELECTRONIC DATA:  
RESTRAINT HARNESS EFFECTS

(Wilcoxon Comparisons A-C and B-D)  
PCU-15/P Harness was used in Test Conditions A and B  
Conventional Harness was used in Test Conditions C and D

MEASURED PARAMETER	INCREASE IN PARAMETER MEAN		HARNESS FOR WHICH THE PARAMETER MEAN WAS LARGER
	W/O CROTCH STRAP A - C	W/ CROTCH STRAP B - D	
	(N = 15)	(N = 14)	
SLED ACCELERATION	NSD	NSD	
SLED VELOCITY	NSD	NSD	
SEAT ACCELERATION	NSD	NSD	
CHEST ACCELERATION			
-X Axis	60% (7.8 G)	39% (6.3 G)	PCU-15/P
+Z Axis	32% (3.7 G)	66% (6.5 G)	PCU-15/P
Resultant	51% (8.3 G)	51% (8.9 G)	PCU-15/P
CHEST SEVERITY INDEX	75% (28.4)	67% (29.1)	PCU-15/P
HEAD ACCELERATION			
-X Axis	NSD	NSD	
-Z Axis	26% (2.4 G)	NSD	PCU-15/P
Resultant	NSD	NSD	
HEAD SEVERITY INDEX	NSD	NSD	
STRAP LOADS			
Total Shoulder Strap	11% (66 lb)	NSD	PCU-15/P
Total Lap Belt	14% (230 lb)	12% (220 lb)	PCU-15/P
Negative G Strap	†	56% (76 lb)	Conventional
VERTICAL SEAT LOAD	10% (140 lb)	NSD	PCU-15/P

This table summarizes the pertinent results of two comparisons by means of the Wilcoxon paired-replicate rank test. Statistically significant differences in response parameters are indicated in terms of percentage and magnitude increases in parameter means ( $2\alpha \leq 0.05$ ). NSD indicates no statistically significant difference in the response parameter in that comparison. A dagger (†) indicates that no comparison was possible, since the negative G strap was present in neither condition.

TABLE 6  
HORIZONTAL TEST PHASE PHOTOMETRIC DATA:  
RESTRAINT HARNESS EFFECTS

(Wilcoxon Comparisons A-C and B-D)  
PCU-15/P Harness was used in Test Conditions A and B  
Conventional Harness was used in Test Conditions C and D

MEASURED PARAMETER	INCREASE IN PARAMETER MEAN		HARNESS FOR WHICH THE PARAMETER MEAN WAS LARGER
	W/O CROTCH STRAP A - C	W/ CROTCH STRAP B - D	
	(N = 11)	(N = 12)	
HEAD DISPLACEMENT			
Horizontal	12% (0.90 in)	NSD	PCU-15/P
Vertical	12% (0.76 in)	NSD	PCU-15/P
Resultant	11% (1.07 in)	NSD	PCU-15/P
KNEE DISPLACEMENT			
Horizontal	15% (0.66 in)	25% (0.97 in)	PCU-15/P
Vertical	NSD	13% (1.07 in)	PCU-15/P
Resultant	NSD	13% (1.09 in)	PCU-15/P

This table summarizes the pertinent results of two comparisons by means of the Wilcoxon paired-replicate rank test. Statistically significant differences in response parameters are indicated in terms of percentage and magnitude increases in parameter means ( $2\alpha \leq 0.05$ ). NSD indicates no statistically significant difference in the response parameter in that comparison.

### C. VERTICAL TEST PHASE: ELECTRONIC DATA

The electronic data obtained during the vertical test phase are summarized in Tables 7 and 8. In Table 7, the effects of adding a negative G strap are presented (comparisons E-F and G-H) and, in Table 8, the restraint configuration effects are presented (comparisons E-G and F-H). These Wilcoxon comparison results are expressed in terms of percentage and magnitude increases in parameter means.

During this test phase, variations in the impact test conditions, presumably due to variations in friction between the vertical rails and the test carriage, were noted. In each of the four comparisons, variations in carriage acceleration, carriage velocity change, or seat acceleration were systematic enough to be seen as statistically significant trends. However, the statistically significant changes among these parameters were relatively small in terms of both magnitude and percentage. All increases were less than 0.6%. These relatively small, but systematic, variations in impact test conditions apparently had no practical influence on the experimental outcome.

Preceding each vertical impact, the subject experienced an approximate +0.1  $G_z$  environment during carriage free fall. This experimental environment was somewhat similar to the environment experienced operationally during aircraft maneuvers. The occupant-seat coupling during carriage free fall was evaluated by analysis of maximum strap and seat loads measured during this phase of the experiment.

As noted in Section 2C, the most critical response parameters during the vertical test phase were the vertical and resultant seat loads which occurred during the impact. Seat loads occurring during carriage free fall were also important. Of secondary importance were the measured body segment (head and chest) accelerations and the associated Severity Indices. Higher seat loads or body segment accelerations during impact were presumed to be indicative of greater vertebral loading and, therefore, less adequate impact protection. Larger vertical or resultant seat loads during free fall were presumably due to better occupant-seat coupling.

In comparison E-F, the effects of incorporating a negative G strap into the PCU-15/P torso harness and lap belt configuration were assessed (Table 7). The 0.3% (0.1 ft/sec) higher carriage velocity change with the negative G strap was presumed to be of no consequence, since the majority of statistically significant increases were in the condition without the negative G strap.

There was a small but statistically significant increase in head Severity Index without the negative G strap. The direction of this trend would appear to be appropriate, but it is difficult to explain in the absence of similar statistically significant trends in component or resultant head accelerations. Theoretically, the head Severity Index finding could be related to a relatively larger number of headstrikes in test condition E than in test condition F. The practical significance of this finding is problematic.

There were no statistically significant differences in component or resultant chest accelerations or chest Severity Index in this comparison. Total shoulder strap load during free fall and total shoulder strap load during impact were also not significantly different in the two test conditions. These findings

TABLE 7

VERTICAL TEST PHASE ELECTRONIC DATA:  
NEGATIVE G STRAP EFFECTS

(Wilcoxon Comparisons E-F and G-H)  
Negative G Strap Absent in Test Conditions E and G  
Negative G Strap Present in Test Conditions F and H

MEASURED PARAMETER	INCREASE IN PARAMETER MEAN		NEGATIVE G STRAP CONDITION FOR WHICH THE PARAMETER MEAN WAS LARGER
	PCU-15/P E - F  (N = 16)	CONVENTIONAL G - H  (N = 15)	
CARRIAGE ACCELERATION	NSD	0.3% (0.03 G)	Present
CARRIAGE VELOCITY	0.4% (0.1 ft/sec)	NSD	Present
SEAT ACCELERATION	NSD	NSD	
CHEST ACCELERATION			
-X Axis	NSD	NSD	
+X Axis	NSD	NSD	
+Z Axis	NSD	9% (1.4 G)	Absent
Resultant	NSD	9% (1.3 G)	Absent
CHEST SEVERITY INDEX	NSD	10% (2.8)	Absent
HEAD ACCELERATION			
-X Axis	NSD	NSD	
+X Axis	NSD	NSD	
+Z Axis	NSD	6% (0.7 G)	Absent
Resultant	NSD	7% (0.8 G)	Absent
HEAD SEVERITY INDEX	5% (1.1)	14% (2.8)	Absent
FREE FALL STRAP LOADS			
Total Shoulder	NSD	44% (41 lb)	Present
Total Lap Belt	10% (24 lb)	NSD	Absent
IMPACT STRAP LOADS			
Total Shoulder	NSD	95% (36 lb)	Absent
Total Lap Belt	25% (22 lb)	48% (41 lb)	Absent
FREE FALL SEAT LOADS			
+Z axis	14% (33 lb)	51% (137 lb)	Present
Resultant	13% (33 lb)	50% (136 lb)	Present
IMPACT SEAT LOADS			
-X axis	NSD	NSD	
+Z Axis	3% (60 lb)	6% (110 lb)	Absent
Resultant	3% (60 lb)	6% (110 lb)	Absent

This table summarizes the pertinent results of two comparisons by means of the Wilcoxon paired-replicate rank test. Statistically significant differences in response parameters are indicated in terms of percentage and magnitude increases in parameter means ( $2\alpha \leq 0.05$ ). NSD indicates no statistically significant difference in the response parameter in that comparison.

are not surprising, because the negative G strap does not attach directly to the PCU-15/P torso harness, but rather to the independent lap belt. As expected, there were small but statistically significant increases in total lap belt load during free fall and impact without the negative G strap. When not tethered to the front of the seat by a negative G strap, the lap belt must carry more load during both free fall and impact. In general, the lap belt is loaded during the free fall phase, unloaded during early impact, and then loaded again later during the impact.

The crucial findings in this comparison were the changes observed in vertical and resultant seat loads during free fall and impact. During the free fall phase, there were approximate 14% (33 lb) increases in vertical and resultant seat loads with the negative G strap present. This is indicative of improved occupant-seat coupling with the negative G strap added to the PCU-15/P torso harness and lap belt configuration. During the impact, vertical and resultant seat loads were 3% (60 lb) higher without the negative G strap, the result of less effective occupant-seat coupling during free fall (dead space effect). These findings are indicative of increased vertebral column loading and, therefore, less adequate impact protection without a negative G strap incorporated into the PCU-15/P configuration. Thus, adding a negative G strap to the PCU-15/P torso harness and lap belt clearly improves the vertical impact protection performance of the restraint system by improving occupant-seat coupling during free fall and reducing vertebral column loading during vertical impact.

In comparison G-H, the effects of incorporating a negative G strap into the conventional double strap and lap belt configuration were considered (Table 7). There was a 0.3% (0.03 G) increase in carriage acceleration with the negative G strap. This finding was believed to be of no practical significance, since the statistically significant increases in other response parameters were in the condition without the negative G strap.

Statistically significant increases in +Z axis and resultant head acceleration and in head Severity Index were observed without the negative G strap. Similarly, statistically significant increases in +Z axis and resultant chest acceleration as well as in chest Severity Index were observed without the negative G strap. All acceleration findings suggest greater vertebral column bending and, therefore, less adequate impact protection without the negative G strap.

The total shoulder strap load was 44% (41 lb) larger during the free fall phase with the negative G strap present. On the other hand, the total shoulder strap load during impact was 95% (36 lb) larger without the crotch strap. The negative G strap, when added to the conventional harness, provides a direct load pathway from the shoulder straps to the seat. This produces a significant improvement in shoulder strap performance and probably results in the lower body segment accelerations also observed in that test condition.

There was no statistically significant difference in total lap belt load during the free fall phase. However, the total lap belt load during the impact phase was 48% (41 lb) higher without the negative G strap. The lap belt, obviously, must carry more load during the impact in the absence of a negative G strap.



Most significantly, the vertical and resultant seat loads during impact were 6% (110 lb) higher with the negative G strap absent. These results were associated with approximate 50% higher vertical and resultant seat loads during the free fall phase with the negative G present. All of these findings are undoubtedly related to the improved performance of the shoulder straps in the conventional configuration with an added negative G strap.

Therefore, incorporating a negative G strap in the conventional double shoulder strap and lap belt configuration produces significant beneficial effects from a vertical impact protection standpoint. The seat load findings indicate that occupant-seat coupling is improved during free fall and that vertebral column loading is decreased during impact when the negative G strap is used. Furthermore, when the results of comparison E-F are compared to the results of comparison G-H, it is apparent that incorporating the negative G strap into the conventional harness produces greater beneficial effects than incorporating the negative G strap into the PCU-15/P configuration.

In comparison E-G, the effects of differences between the two restraint configurations without added negative G straps were examined (Table 8). The carriage acceleration was 0.4% (0.04 G) higher in test condition G. This slight bias in impact test condition was apparently of no practical significance, because the majority of statistically significant increases among the response parameters was seen in test condition E.

There were statistically significant increases in +Z axis and resultant chest accelerations and chest Severity Index in the PCU-15/P configuration. These findings suggest that vertical impact protection is less adequate in the PCU-15/P harness than in the conventional configuration. There were no statistically significant trends in the component or resultant head accelerations or in the head Severity Index.

During the free fall phase, total shoulder strap load was 44% (28 lb) larger and total lap belt load was 24% (62 lb) larger in the conventional configuration than in the PCU-15/P configuration. The straps of the conventional harness obviously carry higher loads in the free fall environment than those of the PCU-15/P configuration. This may be attributed to the fundamental differences in geometry between the two restraint systems. In the conventional harness, the shoulder straps are integrated with the lap belt, whereas, in the PCU-15/P configuration, there is no direct connection between the shoulder straps and lap belt.

However, during impact, the total shoulder strap load was 54% (37 lb) larger in the PCU-15/P configuration than in the conventional harness. There was no significant difference in total lap belt load between the two configurations during impact. The shoulder straps of the conventional harness, therefore, carry significantly more load during the free fall phase and significantly less load during the impact. In so doing, the conventional restraint provides more effective upper torso stabilization than the PCU-15/P configuration, as evidenced by the aforementioned chest acceleration findings.

TABLE 8

VERTICAL TEST PHASE ELECTRONIC DATA:  
RESTRAINT HARNESS EFFECTS

(Wilcoxon Comparisons E-G and F-H)  
PCU-15/P Harness was used in Test Conditions E and F  
Conventional Harness was used in Test Conditions G and H

MEASURED PARAMETER	INCREASE IN PARAMETER MEAN		HARNESS FOR WHICH THE PARAMETER MEAN WAS LARGER
	W/O CROTCH STRAP E - G	W/ CROTCH STRAP F - H	
	(N = 14)	(N = 16)	
CARRIAGE ACCELERATION	0.4% (0.04 G)	0.6% (0.06 G)	Conventional
CARRIAGE VELOCITY	NSD	0.4% (0.1 ft/sec)	PCU-15/P
SEAT ACCELERATION	NSD	NSD	
CHEST ACCELERATION			
-X Axis	NSD	NSD	
+X Axis	NSD	NSD	
+Z Axis	21% (3.4 G)	25% (3.7 G)	PCU-15/P
Resultant	20% (3.3 G)	25% (3.7 G)	PCU-15/P
CHEST SEVERITY INDEX	25% (7.5)	30% (8.2)	PCU-15/P
HEAD ACCELERATION			
-X Axis	NSD	NSD	
+X Axis	NSD	NSD	
+Z Axis	NSD	7% (0.8 G)	PCU-15/P
Resultant	NSD	7% (0.8 G)	PCU-15/P
HEAD SEVERITY INDEX	NSD	8% (1.7)	PCU-15/P
FREE FALL STRAP LOADS			
Total Shoulder	44% (28 lb)	72% (55 lb)	Conventional
Total Lap Belt	24% (62 lb)	14% (33 lb)	Conventional
Negative G Strap	†	179% (143 lb)	Conventional
IMPACT STRAP LOADS			
Total Shoulder	54% (37 lb)	165% (66 lb)	PCU-15/P
Total Lap Belt	NSD	NSD	
Negative G Strap	†	146% (60 lb)	Conventional
FREE FALL SEAT LOADS			
+Z Axis	14% (34 lb)	47% (131 lb)	Conventional
Resultant	13% (32 lb)	46% (129 lb)	Conventional
IMPACT SEAT LOADS			
-X Axis	20% (12 lb)	32% (18 lb)	PCU-15/P
+Z Axis	8% (160 lb)	11% (200 lb)	PCU-15/P
Resultant	8% (160 lb)	11% (200 lb)	PCU-15/P

This table summarizes the pertinent results of two comparisons by means of the Wilcoxon paired-replicate rank test. Statistically significant differences in response parameters are indicated in terms of percentage and magnitude increases in parameter means ( $2\alpha \leq 0.05$ ). NSD indicates no statistically significant difference in the response parameter in that comparison. A dagger (†) indicates that no comparison was possible, since the negative G strap was present in neither condition.

Again, the most important findings were the results of comparisons of the seat load data derived from the two test conditions. Component and resultant seat loads were higher in the PCU-15/P torso harness and lap belt configuration compared to the conventional configuration during the impact. The vertical and resultant seat loads were 8% (160 lb) larger in the PCU-15/P configuration. On the other hand, during the free fall phase, vertical and resultant seat loads were higher in the conventional restraint. These findings are consistent with the interpretation that the conventional harness provides better occupant-seat coupling during the free fall phase and better vertical impact protection than the PCU-15/P torso harness.

In summary, the statistically significant findings among the measured response parameters in this comparison indicate that the conventional configuration is superior to the PCU-15/P configuration from the standpoint of vertical impact protection. This is consistent with the fact that the PCU-15/P torso harness was not specifically designed to provide vertical impact protection, but rather was designed to function as a parachute harness.

In comparison F-H, the effects of differences between the two restraint configurations with added negative G straps were assessed (Table 8). The carriage acceleration was 0.6% (0.06 G) higher in tests of the conventional configuration; the carriage velocity change was 0.04% (0.1 ft/sec) higher in tests of the PCU-15/P configuration. These statistically significant trends in the impact test conditions were small and in opposite directions and, therefore, were of doubtful practical significance.

Statistically significant trends among the response parameters in comparison F-H were similar to the trends found in comparison E-G. In comparison F-H, the +Z axis and resultant chest acceleration and chest Severity Index were higher in the PCU-15/P torso harness and lap belt configuration with an added negative G strap compared to the conventional harness with an added negative G strap. Also, there were statistically significant increases in +Z axis and resultant head accelerations as well as in head Severity Index in the PCU-15/P configuration. These acceleration findings are all indicative of less adequate vertical impact protection in the PCU-15/P configuration with an added negative G strap.

Total shoulder strap load was larger by 72% (55 lb) during the free fall phase in the conventional configuration. However, this load was increased by 165% (66 lb) during the impact in the PCU-15/P configuration. Although the PCU-15/P shoulder straps carry significantly greater loads during the impact, the conventional configuration apparently provides more effective upper torso restraint, as evidenced by the lower chest accelerations and chest Severity Index in the conventional configuration.

Total lap belt load was larger by 14% (33 lb) during the free fall phase in the conventional configuration. There was no statistically significant difference in this load during the impact. These data do not provide a basis for denying the assertion that the lap belt functions similarly during impact in these two harness configurations.

In the conventional configuration, the negative G strap load was higher by 179% (143 lb) and 146% (60 lb) during the free fall phase and impact phase, respectively. These findings are attributable to the harness geometry considerations noted previously. By providing a direct load pathway from the shoulder straps to the seat, the negative G strap greatly improves the load carrying capability of the shoulder straps in the conventional configuration during the free fall phase and carries significantly more load during the free fall phase and impact phase than the negative G strap in the PCU-15/P configuration.

As a result, the function of the conventional harness as a vertical impact protection device is greatly improved. The most significant findings were, again, among the seat load data. The vertical and resultant seat loads were 11% (200 lb) larger during the impact in the PCU-15/P configuration. On the other hand, during the free fall phase, there were approximate 47% larger vertical and resultant seat loads in the conventional configuration. These findings, as in comparison E-G, indicate clearly superior occupant-seat coupling during the free fall phase and significantly less vertebral loading during the impact phase in the conventional configuration with an added negative G strap than in the PCU-15/P configuration with an added negative G strap. In summary, therefore, the findings in comparisons E-G and F-H indicate that the PCU-15/P torso harness and lap belt configuration provides less adequate vertical impact protection than the conventional double shoulder strap - lap belt configuration, regardless of whether a negative G strap is used.

More careful study of the differences between the results of comparisons F-H and E-G provides additional insights into the effects of negative G strap incorporation. Although the statistically significant trends among the response parameters were similar in the two comparisons, several differences are noteworthy. For example, statistically significant trends among the head acceleration data were observed in comparison F-H, indicating superior performance in the conventional configuration. Also, there was a larger increase in shoulder strap load carrying capability during the free fall phase in the conventional harness with an added negative G strap (comparison F-H) than in the conventional harness without a negative G strap (comparison E-G). This finding was coupled with a much larger increase in total shoulder strap load during the impact phase in the PCU-15/P configuration with an added negative G strap than in the PCU-15/P configuration without a negative G strap. Finally, larger increases in vertical and resultant seat loads during impact were seen in the PCU-15/P configuration compared to the conventional configuration when both had added negative G straps (comparison F-H) rather than when neither had negative G straps (comparison E-G).

Observed differences among the response parameters in comparisons E-G and F-H, taken together, indicate that negative G strap incorporation produces greater improvement in vertical impact protection performance in the conventional harness than in the PCU-15/P configuration. These conclusions are also supported by the results of comparisons E-F and G-H.

#### D. MEDICAL FINDINGS

During the horizontal test phase, the medical adverse effects were limited to anticipated, clinically inconsequential findings. The medical adverse effects which occurred as the result of the 10 G experimental level tests are summarized in Table 9.

TABLE 9  
HORIZONTAL TEST PHASE:  
FREQUENCY OF SUBJECTIVE AND OBJECTIVE MEDICAL FINDINGS

TEST CONDITION	A	B	C	D	TOTAL
RESTRAINT HARNESS	PCU	PCU	CONV	CONV	
NEGATIVE G STRAP	NO	YES	NO	YES	
N =	16	15	18	18	67
TRANSIENT PAINS	1	0	3	1	5
PARESTHESIAS	1	0	1	0	2
ABRASIONS	1	0	7	7	15
CONTUSIONS	2	0	2	1	5
MUSCLE STRAINS	1	0	1	0	2
VASOVAGAL REACTIONS	1	0	0	0	1

The abrasions and contusions were found in areas contacting the restraint harness straps. All abrasions occurred in the area beneath the shoulder straps, primarily in the conventional harness. Similar abrasions were probably prevented in many of these tests by placing silk tape between the restraint straps and the subject. Five minor contusions were observed during these 67 impact tests. One was located beneath the shoulder straps, three beneath the lap belt, and one was a groin contusion. The muscle strains were mild posterior cervical strains, which resolved with symptomatic care.

Three subjects experienced transient coccygeal pain following impact in the conventional harness without an added negative G strap (test condition C). This medical finding has been seen in previous  $-G_x$  impact tests in the conventional harness. In other forward facing impact test programs, coccygeal contusions and fractures have been observed.

Notably, there was no significant loading of the groin or genitalia by the negative G strap in test conditions B or D. Subjects did not find it necessary to wear hard cup groin protectors. However, one subject, with a relatively small sitting height, experienced transient groin pain on two occasions (test conditions A and D) and on a third occasion incurred a groin contusion in the inguinal region (test condition C). Note that the negative G strap was not used in test conditions A or C. Why these adverse effects were experienced by this subject is not clear. Remarkably, no medical adverse effects were documented in test condition B, in which the PCU-15/P torso harness and lap belt with an added negative G strap was evaluated.

The most significant, but still clinically inconsequential, medical finding was a vasovagal reaction. The subject, M-13, experienced right shoulder pain during the impact in test condition A. Following the impact, the subject became diaphoretic, mildly bradycardic, and mildly hypotensive. Vital signs improved in 8 to 10 minutes, after the subject assumed a head-dependent position. The further voluntary participation of this subject in impact tests was not influenced by this experience.

During the horizontal test phase, 12 orientation tests were conducted at the 6 G level and 21 orientation tests were conducted at the 8 G level. In the 6 G tests, two subjects experienced abrasions, one subject had a contusion, and two inexperienced subjects experienced mild cervical strains. In the 8 G tests, ten subjects experienced abrasions and one subject incurred a contusion.

Subject attrition during this test phase was not unusual. One subject (P-4) terminated his participation due to a new duty assignment. He withdrew from the test program having completed the 8 G orientation exposure and one impact at the 10 G level (test condition C), during which he incurred an abrasion and a cervical strain. (These data are not included in Table 9.) Another subject (W-3), having completed the 6 G and 8 G orientation exposures, voluntarily withdrew from the test program due to excessive pretest anxiety. A third subject (B-2) also voluntarily withdrew from the program following 6 G, 8 G and two 10 G exposures. This subject also cited excessive pretest anxiety as the reason for terminating his participation.

In summary, 101 human impact tests were conducted during the horizontal test phase of this study. Sixty-eight tests were at the 10 G experimental level and 33 tests were at the 6 G and 8 G orientation levels. These exposure levels were found to be well within human impact tolerance and no clinically consequential medical adverse effects were noted during any of the experiments. No medical contraindications to negative G strap incorporation in either restraint were found.

During the vertical test phase, only a few medical adverse effects were encountered (Table 10). All were clinically inconsequential.

One subject (B-1) experienced transient cervical pain during both exposures in the PCU-15/P configuration. Another subject (E-2) experienced mild posterior cervical strains in both negative G strap test conditions. Review of the photometric data revealed that these medical adverse effects were related to hyperextension of the cervical spine during the impact. Similar effects have been seen in other vertical impact tests with the headrest 1 inch aft of the seat back plane (Hearon *et al.*, 1983). Predisposing factors include the subject's efforts to maintain his initial position (head against headrest) and the relatively poor upper torso support afforded by the PCU-15/P torso harness, which was used in three of the four cases above. As a result of the mild posterior cervical strains experienced, subject E-2 voluntarily withdrew from the test program.

Seventeen orientation tests at the 8 G level were conducted during the vertical test phase. No medical adverse effects were encountered in any of these tests.

TABLE 10  
VERTICAL TEST PHASE:  
FREQUENCY OF SUBJECTIVE AND OBJECTIVE MEDICAL FINDINGS

TEST CONDITION RESTRAINT HARNESS NEGATIVE G STRAP	E PCU NO	F PCU YES	G CONV NO	H CONV YES	TOTAL
N =	16	17	15	16	64
TRANSIENT PAINS	3	1	0	0	4
MUSCLE STRAINS	0	1	0	1	2

In summary, 81 human impact tests were conducted during the vertical test phase, 64 at the 10 G experimental level and 17 at the 8 G orientation level. These exposure levels were well within human tolerance, as no clinically consequential medical adverse effects were encountered. Finally, no medical contraindications to negative G strap incorporation in either harness were noted.

#### E. SUBJECTIVE DATA

Following each experimental level impact in this series, the subject was administered a questionnaire designed to evaluate subjective impressions before, during, and after the impact. The subject was asked to evaluate various test-related sensations on a seven integer scale from -3 to +3 with 0 indicating a neutral response. For example, shoulder strap and lap belt pressures were assessed as relatively high or relatively low. Head displacement during the impact was relatively large or relatively small. The overall impact experience was relatively uncomfortable or relatively comfortable.

The integer responses to each question were analyzed in two ways. First, the mean subject response to each question in each test condition was computed. This average response value was compared to the mean response for the same question in a comparable test condition. This approach permitted general conclusions regarding the subjective responses to be drawn. Second, closer analysis of these data was accomplished by searching for question response trends in comparable test conditions. Specifically, the numbers of subjects giving more favorable or less favorable responses to the same question in comparable test conditions were compared.

First, data collected during the horizontal test phase are presented. In the static, pretest condition, subjects generally perceived shoulder strap and lap belt pressures to be higher in the PCU-15/P configuration than in the conventional configuration. Also, the general overall impression of the seat and harness was that the PCU-15/P configuration was more uncomfortable than the conventional harness. For example, eight subjects believed that the PCU-15/P configuration with an added negative G strap was more uncomfortable than a similarly configured conventional harness, while only one subject believed the reverse to be true and five subjects perceived no difference.

During the impact, subjects generally believed that shoulder strap pressure was higher with the negative G strap than without it. For example, nine subjects believed that shoulder strap pressure was higher in the conventional configuration with an added negative G strap than in the conventional configuration without a negative G strap, three subjects believed the opposite was true, and five subjects perceived no difference. Measured shoulder strap load during impact was, in fact, significantly higher with the negative G strap than without the negative G strap in both the PCU-15/P configuration and the conventional configuration. (See comparisons A-B and C-D in Section 3B.)

Second, data derived from the vertical test phase are presented. In the static, pre-impact test condition, subjects again generally perceived shoulder strap and lap belt pressures to be higher in the PCU-15/P configurations than in the conventional configurations, regardless of negative G strap. Specifically, six subjects believed that shoulder strap and lap belt pressures were higher in the PCU-15/P harness without negative G strap than in the conventional harness without negative G strap, while only one subject believed the converse was true and seven subjects perceived no difference. Also, the general overall impression of the seat and harness was that the PCU-15/P configuration was less comfortable than the conventional configuration. Similarly, six subjects felt that, overall, the PCU-15/P configuration without negative G strap was less comfortable than the conventional configuration without negative G strap, while only one subject believed the reverse to be true and seven subjects perceived no difference.

Even stronger trends in the subjective data were found in comparison F-H. Twelve subjects believed that lap belt pressure was higher in the PCU-15/P configuration with an added negative G strap than in the conventional configuration with an added negative G, while only one subject believed the contrary. Finally, eleven subjects believed that the PCU-15/P configuration with an added negative G strap was less comfortable, overall, than the conventional configuration with an added negative G strap, while only one subject believed the reverse to be true.



During the impact, subjects' impressions of the PCU-15/P configuration were less favorable than their impressions of the conventional configuration. Subjects generally believed that shoulder strap and lap belt pressures were higher, head displacements were larger, and neck and back were less comfortable in the PCU-15/P configuration than in the conventional configuration. For example, a plurality of five subjects believed that shoulder strap pressure was higher and a plurality of nine subjects believed that lap belt pressure was higher in the PCU-15/P configuration without the negative G strap than in the conventional configuration without the negative G strap. Measured shoulder strap load during impact was, in fact, higher in the PCU-15/P configuration than in the conventional configuration, regardless of the negative G strap. (See comparisons E-G and F-H in Section 3C.) However, there was no statistically significant difference in total lap belt load during impact between the two restraint configurations.

In summary, then, the subjective data from both test phases are generally consistent with the foregoing objective test data. The PCU-15/P configuration clearly was not favored by subjects in either test phase. In addition, negative G strap incorporation into the conventional configuration was not favored for forward facing impacts.

## SECTION 4

### DISCUSSION

#### A. NEGATIVE G STRAPS EFFECTS

In assessing the utility of negative G or crotch strap incorporation into various restraint systems, it is useful to consider the negative G strap functions separately in the operational and impact contexts. In the operational context, the perceived user benefit of negative G strap incorporation is the improved support during  $-G_z$  acceleration maneuvers resulting from decreased upward rotation of the lap belt. In some restraint configurations, the negative G strap links the shoulder straps to the lower seat structure, thereby permitting shoulder strap loads to be carried to the seat.

In recent years, various operational incidents have focused attention on the need to improve man-seat coupling during sustained  $-G_z$  accelerations in high performance aircraft. Such incidents include reports of helmet-canopy contact and survival kit release from the seat during  $-G_z$  maneuvers. In one case, an F-4 pilot incurred a cervical fracture with neurologic sequelae due to helmet-canopy contact. This resulted in permanent paralysis of that crewmember and nearly resulted in loss of the aircraft and both crewmembers.

In the impact context, the primary perceived benefit of negative G strap incorporation is to decrease the likelihood of torso submarining under the lap belt during  $-G_x$  impact acceleration. By tethering the lap belt to the lower seat structure, the negative G strap reduces the tendency for the lap belt to rotate up and over the anterior superior iliac crests of the pelvis. During such forward facing impacts, shoulder strap loads may also be carried to the lower seat structure in a manner similar to the sustained  $-G_z$  case, but the origin of the  $-G_x$  loading is different and the load magnitude is greatly increased.

The perceived risk of negative G strap incorporation is primarily the potential for groin injury during a  $-G_x$  impact associated with ejection or aircraft crash. Avoiding significant submarining in such cases is essential to prevent loading of the anterior abdominal wall by the lap belt and, therefore, the risk of catastrophic internal injury. A correctly designed restraint does not prevent submarining by the application of direct negative G strap loading of the genitalia and groin. Nevertheless, such loading is conceivable, particularly with a loosely adjusted lap belt or an inferior negative G strap attachment located too far aft for the crewmember in question.

Some operational experience with crotch straps has been accrued in foreign military services, notably the United Kingdom, and in the T-38 aircraft of the USAF Thunderbirds. However, the most extensive USAF operational experience with a restraint harness which incorporates a negative G strap has been with the harness of the F/FB-111. Operational ejection experience in the F/FB-111 has been discouraging in view of the relatively high rate of vertebral fracture among survived ejectees (Hearon et al., 1982). However, among all ejection-related injuries, only one scrotal laceration and two thigh contusions may be attributed to the presence of the negative G strap in the F/FB-111 system. The crewmember who incurred the 5 cm scrotal laceration also suffered multiple vertebral fractures during a near nose-down landing impact of the crew module resulting from

a failure of the parachute suspension system (Hearon, 1981). The ejection data, therefore, suggest that the F/FB-111 crotch strap functions without producing significant injury to the genitalia or groin. In fact, a clinically consequential vertebral fracture is apparently more likely to occur than a clinically consequential injury to the genitalia or groin.

Extensive impact testing of the F/FB-111 restraint system (with the shoulder strap anchor points slightly modified) has recently been conducted (Brinkley et al., 1981). One-hundred and eighty-seven human tests in all three cardinal axes were performed. These included vertical impact exposures up to 10 G peak (26 ft/sec), forward facing impacts up to 10 G peak (32 ft/sec), and sideward or lateral impacts up to 8 G peak (30 ft/sec). The largest negative G strap loads were recorded for the lateral impact tests. A possible explanation for this finding is that, during lateral impact, the subject's thigh directly impacted the crotch strap. This resulted in a number of abrasions and contusions of the upper medial thigh in the area of contact. However, no clinically consequential injuries to the groin or genitalia were found. During the -G<sub>x</sub> test phase, subjects initially wore hard cup groin protectors, as the potential for groin injury in the proposed tests was unknown. However, several subjects believed that the hard cup protector enhanced rather than mollified the discomfort and, therefore, the use of these devices was discontinued without medical consequence. Finally, during the vertical impact tests, no subjective complaints or objective medical findings were associated with the negative G or crotch strap. All impact exposures were performed after the shoulder straps and lap belts were tightly pretensioned to 15-20 lb per strap. It is anticipated that similar impact exposures with untensioned straps would provide an opportunity for increased injury risk.

In view of the aforementioned background, the present study was undertaken primarily to document the benefits and risks associated with negative G strap incorporation into the PCU-15/P torso harness and lap belt configuration. This research effort is part of the ongoing ACES II Upgrade Program in which a variety of proposed retrofit modifications to the ACES II are being evaluated. This study also used a standard double shoulder strap - lap belt configuration as a comparison or control test condition.

Negative G strap incorporation into the PCU-15/P torso harness and lap belt configuration was clearly demonstrated to have beneficial effects in this study. In the horizontal test phase, the tendency toward submarining was decreased, as evidenced by the small but statistically significant decreases in vertical and resultant knee displacements with the added negative G strap. There were no statistically significant changes in body segment accelerations, the associated Severity Indices, or vertical seat load with the added negative G strap. In the vertical test phase, analysis of vertical and resultant seat loads indicated improved man-seat coupling during carriage free fall and reduced vertebral column loading during impact with the added negative G strap.

Negative G strap addition to the conventional double shoulder strap and lap belt configuration was associated with clearly beneficial effects in the vertical test phase. There was improved occupant-seat coupling during carriage free fall and vertical impact response was more benign with the added negative G strap. The latter was evidenced by lower resultant head and chest accelerations, lower head and chest Severity Indices, and lower vertical and resultant seat loads. However, both beneficial and potentially detrimental effects were observed

during the horizontal test phase. The negative G strap very effectively reduced the tendency toward submarining in the forward facing tests, as evidenced by lower component and resultant knee displacements. However, the forward inertial response of the torso was increased, as evidenced by increases in -X chest acceleration and chest Severity Index. Increased vertical seat load was observed but, as previously discussed, its significance remains unclear on the basis of current data.

Also noteworthy was the absence of clinically consequential medical adverse findings among the tests in this series. There were thus no medical contraindications to negative G strap incorporation in either restraint system. The subjective data obtained from the post-test questionnaire revealed that subjects had no clear preference for or against the negative G strap. The notable exception was in the horizontal test phase, when the conventional restraint without the crotch strap was preferred to the same harness with the crotch strap.

In summary, these tests demonstrated that negative G strap incorporation into the PCU-15/P configuration or the conventional configuration (1) reduced the tendency toward submarining during 10 G (30 ft/sec) forward facing impact accelerations, (2) improved occupant-seat coupling during free fall, and (3) improved vertical impact protection performance during 10 G (26 ft/sec) exposures. In addition, during the forward facing impacts, negative G strap incorporation produced no adverse changes among critical response parameters in the PCU-15/P configuration, and only raised the question of possible performance degradation in the conventional configuration. Finally, no medical contraindications to negative G strap incorporation were found in this study.

In a concurrent study performed on the AFAMRL Dynamic Environment Simulator (DES), negative G strap addition to the PCU-15/P configuration was shown to have a beneficial effect in a sustained -2.0  $G_z$  environment. Although no statistically significant differences in tracking task performance were found, subject vertical displacement from the seat was significantly less when the negative G strap was used (Leupp & Frazier, 1982).

It should be noted that the negative G strap evaluated in this study represents only one approach to provide the anticipated benefits. The function of the crotch strap in forward facing impacts might be more effectively served by a split or inverted V crotch strap with the lower attachment points separated at the rear seat corners. Such inverted V straps were part of the restraint systems used during early - $G_x$  impacts conducted on the rocket sled at Holloman Air Force Base, New Mexico (Stapp, 1951). Typical acceleration profiles extended from 28 to 36 G with onset rates of 500 to 1500 G/sec and velocity changes near 700 ft/sec. These human exposures were tolerated without significant pelvic injury.

Further forward facing impact tests with volunteer subjects are planned at AFAMRL to compare response with a split or inverted V crotch strap to response with a single crotch strap. Other configurations are also conceivable. For example, the upper attachments of the negative G strap to the lap belt may be separated as well as the lower attachment points. These alternatives to the single crotch strap arrangement might improve forward facing impact protection in the conventional configuration.

Finally, it is not possible to quantitatively predict the operational injury potential associated with negative G strap incorporation. It may be presumed that the greatest likelihood for injury in an open ejection seat is during transient  $-G_x$  accelerations resulting from seat deceleration with drogue parachutes or from aircraft crash landing. However, all indications from the relevant operational and experimental data are that operational injuries of the groin or genitalia due to negative G incorporation into the PCU-15/P configuration will be unlikely. Furthermore, those which occur are likely to be clinically inconsequential or to be associated with unrelated but more serious injuries in other organ systems. These conclusions, of course, are predicated on the consistent proper adjustment and pretensioning of an appropriately designed restraint system.

On the basis of these test results and other available evidence, sufficient benefits appear to derive from use of the negative G or crotch strap to warrant a recommendation for its incorporation into selected USAF restraint systems, notably the PCU-15/P torso harness and lap belt configuration. Designs for incorporation should be based on knowledgeable exploitation of potential benefits and avoidance of potential hazards.

## B. RESTRAINT HARNESS EFFECTS

By virtually all evaluation criteria, the PCU-15/P configuration was found to be inferior to the conventional configuration. In the horizontal test phase, this inferiority was evidenced by larger component and resultant chest accelerations, higher chest Severity Index, and higher vertical seat load in the PCU-15/P configuration. When a negative G strap was added to both configurations, there was improvement in the performance disparity between the configurations. However, the PCU-15/P configuration with an added negative G strap still provided less adequate  $-G_x$  impact protection than the conventional configuration, as evidenced by higher chest acceleration and chest Severity Index in the PCU-15/P configuration.

The PCU-15/P configuration also provided less adequate vertical impact protection than the conventional configuration. This was evidenced by higher  $+Z$  and resultant chest accelerations, chest Severity Index, and vertical and resultant seat loads in the PCU-15/P configuration. The observed disparity in performance between the two harnesses widened with negative G strap incorporation. For example, adding negative G straps to both configurations increased the differences in vertical and resultant seat loads between the two harnesses. In addition, statistically significant increases in  $+Z$  and resultant head accelerations and head Severity Index were noted in the PCU-15/P configuration with an added negative G strap compared to the conventional configuration with an added negative G strap.

There was no medical injury evidence disclosed by this test program to indicate that one harness configuration was preferable to the other. However, the subjective data provided on post-test questionnaires revealed that subjects clearly preferred the conventional configuration over the PCU-15/P configuration, particularly in the vertical test phase.

In summary, then, the photometric, electronic, and subjective data derived from this test program indicate that the conventional harness is clearly preferable to the PCU-15/P configuration for vertical and forward facing impacts, regardless of whether a negative G strap is used. This finding is not surprising in view of the obvious geometric differences between restraint systems. In the conventional configuration, there is better integration of the lap belt and shoulder straps. Addition of the negative G strap provides a direct load pathway by which shoulder strap loads may be carried to the seat structure. On the other hand, in the PCU-15/P configuration, the lap belt with or without the added negative G strap is not directly attached to the shoulder straps of the torso harness. The relatively poor integration among the restraint straps causes the PCU-15/P configuration to be a relatively poor impact protection device. This is not surprising, since the system was originally designed to function as a parachute harness.

Adding a negative G or crotch strap to the lap belt of the PCU-15/P configuration will improve the impact protection performance of this restraint system. Additional research at AFAMRL is in progress to identify restraint harness features which may further improve the performance of current as well as future USAF restraint systems.

Finally, the present test results improve our understanding of restraint configuration effects observed in another test program. The previous vertical impact tests (Hearon et al., 1983) indicate that the conventional configuration without an added negative G strap provides less adequate impact protection than the F/FB-111 restraint system. This conclusion was based on the finding of significantly higher vertical and resultant seat loads in the conventional configuration than in the F/FB-111 configuration. Speculation was that these differences were due to the presence of a negative G strap in the F/FB-111 configuration. The findings in the vertical test phase of the present study support this speculation, since addition of the negative G strap to the conventional configuration significantly improves vertical impact protection. Further clarification of differences in restraint dynamics between the conventional and F/FB-111 configurations may be achieved by additional vertical impact tests of a single subject sample in the F/FB-111 configuration and the conventional configuration with an added negative G strap.

### C. TECHNICAL NOTES

The following technical notes concern the electronic data processing and analysis carried out in this study. The comments are intended to clarify modifications deliberately made to the measured electronic data and to explain the technique used to analyze the load data.

Tare tests of both test fixtures were performed in order to assess the influence of seat pan mass on the supporting load cells. The product of the mass supported by each load cell and the instantaneous sled (or carriage) acceleration was subtracted from the appropriate load cell data acquired during a human test. In this way, the measured data were corrected for the effect of seat pan mass. In the forward facing tests, the horizontal seat load was corrected for tare load. In the vertical tests, the vertical seat load was corrected for tare load.

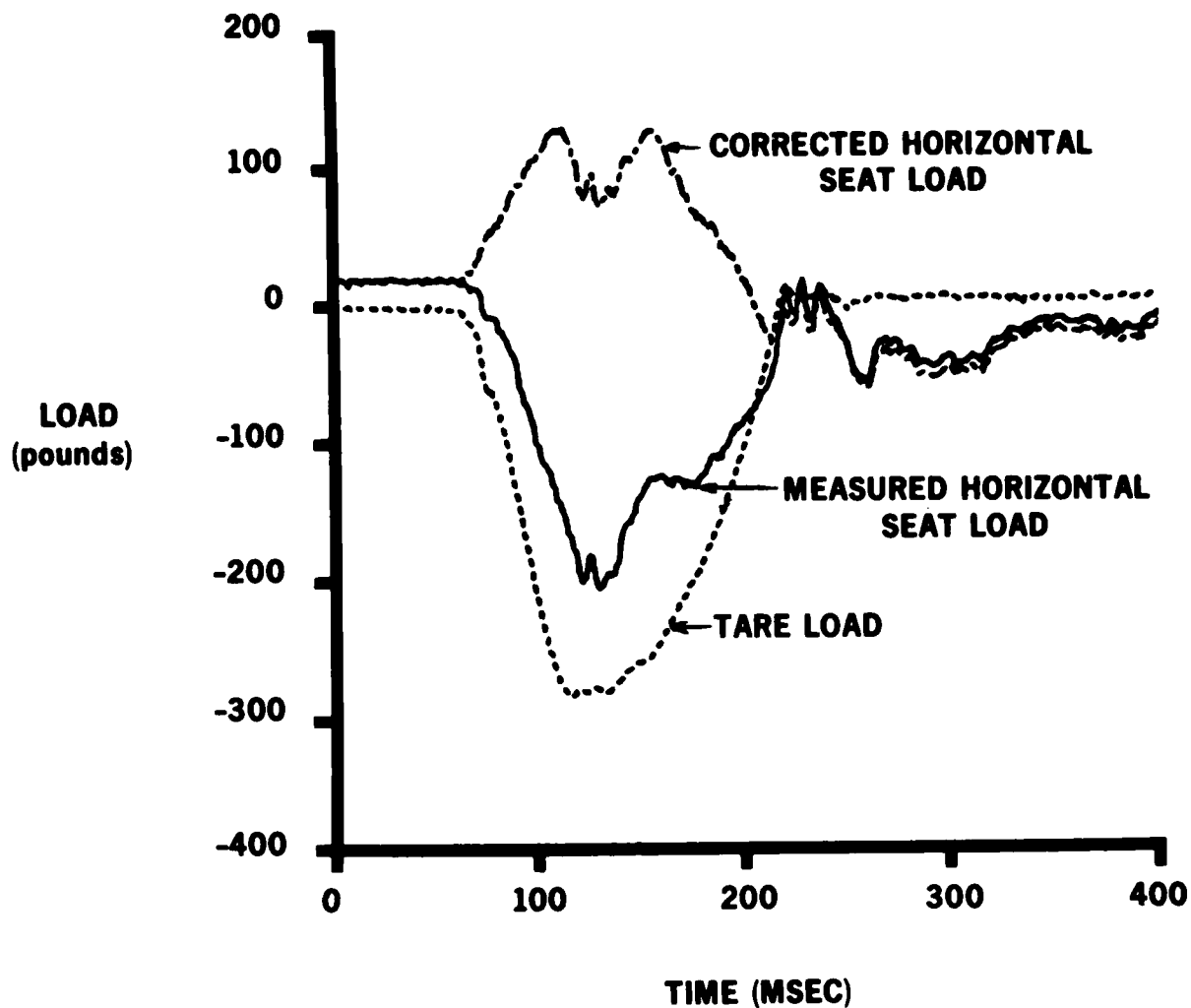


Figure 7. Comparison of Measured Horizontal Seat Load and Corresponding Computed Tare Load for a Typical Forward Facing Test

In the horizontal test phase, difficulty was encountered in the analysis of the horizontal seat load data corrected for tare load. The actual measured horizontal seat load was occasionally smaller than and often lagged the computed tare load (Figure 7). The lag of the measured load is apparently due to a phase shift between the horizontal sled acceleration and the measured horizontal seat load. However, the lower peak seat loads compared to tare loads observed in some tests has not been explained. The difference between measured seat load and computed tare load yielded a corrected horizontal seat load, which was an initially positive or upward going function in virtually all cases. Given the forward inertial response of the subject during early impact, an initially positive horizontal seat load is physically impossible. In the absence of a reasonable explanation for this finding, all horizontal seat load data corrected for tare load, as well as resultant seat load data, were omitted from analysis in the horizontal test phase.

In the vertical test phase, of course, the vertical seat load data were corrected for tare load. A similar problem was not apparent among these data, possibly because the measured vertical seat loads were at least an order of magnitude greater than the computed tare loads.

Negative G strap data in the vertical test phase were not corrected for tare load. The negative G strap was unloaded during carriage free fall and negative tensions were recorded by the associated load cell, particularly in the PCU-15/P configuration. This was due to the mass of the negative G strap and attachment fitting acting on the load cell during carriage free fall. The maximum negative tensions measured were approximately 4 to 6 lb, which would be expected for the mass of the strap and attachment fitting.

The occurrence of a subject striking his head against the headrest during the rebound phase of a forward facing impact was noted on several occasions during photometric and electronic analog data review. These headstrikes were associated with relatively large increases in +X head acceleration well after the impact, during the rebound phase. These accelerations, in fact, were often larger than the maximum X head acceleration experienced during the impact phase of the experiment. When this occurred, the electronic data base was modified by removing the late spike in X head acceleration so that the recorded maximum was the value which actually occurred during the impact phase of the experiment. This assured that the impact response values for head X acceleration would be comparable. Comparison of impact values with rebound values was thereby avoided.

Behavior of the restraint strap loads during the vertical test phase is worthy of technical note. In both the PCU-15/P and conventional configurations, the lap belt and crotch strap were loaded during carriage free fall, unloaded early in the impact, and then loaded later during the impact event. The peak load occurring during the free fall phase was defined as the pre-impact maximum. The minimum load occurring early in the impact was the impact minimum. Finally, the subsequent peak load was termed the impact maximum. Shoulder strap loads in the conventional harness behaved in a similar manner, but there was relatively less unloading during early impact than for the lap belt or crotch strap. The shoulder strap load profile of the PCU-15/P configuration, however, did not show this biphasic pattern. Instead, these profiles were monophasic, the early minimum being absent. Examples of the recorded strap loads in the various test conditions are presented in Appendix C.

The manner in which the strap load and structural load data were analyzed is also noteworthy. A formidable problem in interpreting such data is that the peak loads vary widely among subjects. One approach to minimize the differences among subjects is to normalize the load response data by, for example, dividing the measured load by subject weight. Recently, our approach has been to use the Wilcoxon paired-replicate rank test so that each subject may act as his own control thereby minimizing the effects of biological variability on the data.



Although this statistical technique has been shown to be useful, it does not take into account the variations in pre-impact conditions for a single subject from test to test. For example, there may be minor differences from test to test in initial conditions such as body position, body muscle tension, and harness pretensions. These variations may substantially influence pre-impact strap and structural loads and, ultimately, influence the magnitude of the impact response values.

In order to minimize the influence of initial condition variations on the measured impact load data in this study, analysis of the difference between impact and pre-impact values was accomplished. Wilcoxon analyses of these differences obtained using immediate pre-impact values or averages as baseline were performed. (See also Section 2C.) The results of these analyses have already been presented. However, additional Wilcoxon analyses were accomplished using zero as baseline. Comparison of the results obtained using these two techniques revealed that the former (pre-impact baseline) produced additional statistical information not found using the latter (zero baseline) technique. Furthermore, the additional findings were valid with a high degree of statistical confidence and did not contradict the findings produced by the other technique. For example, in comparison E-F, statistically significant increases in vertical and resultant seat loads were found without an added negative G strap at the 90% confidence level when zero was used as baseline. However, when the immediate pre-impact value was used as baseline, a similar but larger percentage increase in the parameter means was observed in the same comparison at the 98% confidence level. The technique of strap and structural load analysis developed in this study, therefore, appears to be a useful means of accommodating variations in initial conditions.

## APPENDIX A

### USE OF HUMAN SUBJECTS

All human volunteer subjects who participated in this test program were members of the AFAMRL Impact Acceleration Stress Panel. This panel is composed of volunteer active duty USAF members whose primary duties do not involve participation as subjects. Twenty-one subjects (20 males and 1 female) were used during this test program. There were no special technical qualifications or training requirements for subjects.

However, all subjects were qualified to participate only after successfully completing an intensive medical screening evaluation (Hearon & Raddin, 1981). This evaluation was directed by the panel physician and consisted of medical history screening, physical examination, visual acuity testing, audiometry, blood pressure measurement, routine laboratory examination (blood work and urinalysis), standard 12-lead electrocardiogram, pulmonary function tests, electroencephalogram, treadmill exercise stress test, and x-rays, including chest, skull, and complete spine films. The x-rays were reviewed by the panel physician in consultation with a radiologist (and orthopedic surgeon, as necessary) to assure elimination of individuals with disqualifying radiographic findings. The female subject had a negative pregnancy test documented and underwent a pelvic exam by a gynecologist, to assure there were no gynecologic contraindications to her participation. Relevant abnormalities in any part of the medical evaluation led to elimination of the candidate or specialty consultation and further examination, as required. Annual requalification of panel members was accomplished with a limited medical evaluation, including a physical examination and other relevant medical tests.

The generic human use protocol under which these impact tests were conducted was the AFAMRL "Generic Impact Acceleration Protocol". This document presented a survey of available human biodynamic test data, established broad generic exposure limits for human impact testing, and described the generic medical risks associated with such tests. Following review by the AFAMRL Human Use Review Committee (HURC), the protocol was recommended for approval by higher authority. Subsequently, the protocol was approved by AFAMRL/CC and, as SGO R-82-001, it was reviewed and approved by USAF/SG.

The specific human use protocols under which these impact tests were conducted were AFAMRL Protocol 81-40, "Evaluation of Restraint Harness Configuration During -G<sub>x</sub> Impact Acceleration", and AFAMRL Protocol 82-07, "Evaluation of Restraint Harness Configuration During +G<sub>z</sub> Impact Acceleration". The overall risk of injury to human subjects was judged acceptable when compared to the negative G strap data base that would be acquired. The protocols were reviewed and recommended for approval by the AFAMRL/HURC on 5 Nov 81 and 1 Apr 82, respectively, and were subsequently approved by AFAMRL/CC.

Ongoing informed consent was provided by all subjects during the test program in accordance with the guidelines in AFR 169-3. Prior to testing, subjects received a thorough briefing on the experimental procedures and potential

medical risks of participation. The subjects signed a witnessed consent form attesting to the fact that a detailed briefing was received and summarizing its content. Throughout the test program, the medical investigator continued to stress that any subject was free to withdraw at any time for any reason.

Subject preparation was concurrent with preparation of the test fixture and instrumentation. Prior to every impact exposure, each subject provided a brief interval medical history and was physically examined. Emphasis was placed on neck or back symptoms, medications, abnormalities of recent sleep patterns, or recent overindulgence in food or alcoholic beverages. No subject was exposed with symptoms which may have obscured detection of test-related injury or which may have indicated predisposition to such injury.

All subjects wore cut-off, long underwear to allow mounting of camera targets (fiducials) and instrumentation. Male subjects wore athletic supporters. Each subject was instructed to void prior to entering the test area.

A disposable dental bite block (made of Optosil placed over a stainless steel frame) was molded for each subject prior to each impact test. An electrically-isolated accelerometer array was then mounted on the metal frame of the bite block. A portion of the metal frame extended from the mouth of the subject to permit the mounting of a photometric target. This permitted more precise quantification of subject head displacement and better correlation of electronic and photometric data.

The medical instrumentation of each subject was standardized as follows. Three stick-on EKG electrodes were placed on the subject, one on the upper posterior aspect of each arm and a third on the right lateral chest, sixth intercostal space, mid-axillary line. The snap-on lead from each of these electrodes was plugged into a telemetry transmitter, which, in turn, was strapped to the upper arm of the subject. Continuous remote transmission of a single-lead EKG to a portable EKG machine located near the testing area was assured prior to each impact. Sitting and standing tracings were obtained immediately pre-impact (and post-impact) and a continuous tracing was obtained during test countdown and impact. Coincident with EKG recording, pretest (and post-test) sitting and standing blood pressure determinations were made for each subject by the medical technician using a sphygmomanometer. These pressures were recorded on the appropriate EKG tracing.

For vertical impacts, the subject was fitted with a USAF HBU-26/P flight helmet. Helmets were not used during the horizontal test phase, since their use would have increased the likelihood of a paracervical muscle strain. Prior to impacts in either test phase, the subject was seated in the test fixture and asked to exhale. Then, the chest accelerometer array was secured against the chest with a Velcro strap. The restraint harness was adjusted while the subject was in a fully upright position. The shoulder straps and lap belt straps were pretensioned to  $20 \pm 5$  lb. Stick-on photometric targets were placed on the subject at pre-determined locations and the positions of these targets relative to one another and to targets mounted on the test fixture were measured. Finally, the shoulder strap angles (relative to a reference horizontal) were measured with an inclinometer.

The subject was instructed not to brace with his upper extremities prior to impact. He was instructed to simply rest his hands in his lap. The subject was also instructed to brace his head against the headrest, in an attempt to minimize the forward and downward displacement of his head during the impact.

The final pretest activity consisted of documentation of the test configuration by still photographs, measurement of subject blood pressure, evaluation of the electrocardiographic tracing by the medical monitor, and final safety checks of the test equipment and facility by the designated safety monitor. For the vertical test phase, the impact carriage was raised to the specified drop height, the test area was cleared, and after countdown the carriage was allowed to free fall onto the water-filled brake to produce the desired impact. For the horizontal test phase, the impulse accelerator was pressurized, the test area was cleared, and after countdown the system was actuated to accelerate the sled.

The subject was provided with a hand-held switch which was connected to the impact facility control system in such a way that the impact could not occur unless the switch was depressed. In this manner, the subject was required to consciously provide his ongoing informed consent throughout the immediate pre-impact period (including the countdown) in order for the test to proceed.

A physician monitor, who was responsible for assuring subject safety during testing, was present for each test and reserved the right to cancel any test at any time for any reason. Such reasons may have included a recent history of neck or back strain, pretest pre-syncope, pretest arrhythmia, or any other condition of the subject, equipment, or procedure which was deemed by the monitor to place the subject at undue risk. The medical monitor was provided a switch similar in function to the subject's switch. It had to be depressed prior to carriage release in order for the test to proceed. Agreement of both the subject and the medical monitor that the test should proceed was thus assured.

During testing, an ambulance crew was alerted and standing by within one-half mile of the test facility. In addition, emergency medical equipment was arranged in the test area for use by the physician monitor in the event of an emergency. This equipment included a defibrillator, oxygen equipment, intubation equipment, IV solutions and equipment, appropriate emergency drugs, backboard, harness cutters, and bandages.

Following the impact exposure, the subject was released from the harness. The physician monitor assured that the subject was uninjured. Post-test blood pressures and EKG (single-lead) were obtained and a brief post-test physical examination was accomplished. The subject was then provided with contacts to obtain later medical care as required or to ask questions relating to his participation. Impact exposures for each subject occurred no more frequently than once in any five-day period to allow time for detection of any occult injury.

Anthropometric measurements of all subjects participating in this test program were obtained. Table A-1 provides a summary of selected anthropometric values for each subject. The means and standard deviations computed from these dimensions compare favorably with the means and standard deviations of the dimensions obtained from an anthropometric survey of USAF personnel conducted in 1967 and published in AFSC Design Handbook 2-2. Forty-nine anthropometric measurements of each subject in this test program were obtained. A collective anthropometric summary of selected measurements is shown in Table A-2.

TABLE A-1  
INDIVIDUAL SUBJECT ANTHROPOMETRY

SUBJECT ID CODE	AGE (yrs)	WEIGHT (lb)	STATURE (in)	SITTING HEIGHT (in)	MID-SHOULDER SITTING HEIGHT (in)
B-2	23	186	69.4	37.1	26.2
B-4	26	197	69.0	36.9	25.8
B-1	21	147	70.5	37.0	25.7
B-3	34	182	71.0	35.7	25.2
C-1	26	168	69.8	37.6	26.3
C-2	29	180	70.0	37.1	25.2
E-2	25	172	70.1	36.8	25.0
F-2	26	159	67.1	37.5	26.3
G-3	25	164	67.1	34.8	25.0
H-6	24	188	69.4	36.9	26.6
J-3	26	175	70.4	36.1	25.4
J-4	19	187	73.0	37.9	27.2
K-1	26	169	67.1	35.7	24.8
M-13	36	169	73.0	37.3	26.3
P-3	25	198	72.8	39.1	27.7
R-2	24	148	68.1	35.9	24.3
R-3	23	146	66.2	35.2	23.9
S-6*	24	115	62.0	32.8	22.4
T-1	28	164	66.3	35.9	25.2
W-3	30	167	71.2	37.5	26.9
W-4	24	190	70.2	37.5	26.4
MEAN	25.9	168	69.0	36.5	25.5
STD DEV	3.90	21.5	2.82	1.35	1.24

\* Female subject

TABLE A-2  
COLLECTIVE SUBJECT ANTHROPOMETRY

ANTHROPOMETRIC MEASUREMENT	MEAN	STD DEV	RANGE	
Weight	168	21.5	115	- 198
Stature	69.0	2.82	62.0	- 73.0
Cervicale Height	59.1	2.50	53.7	- 63.8
Trochanteric Height	36.3	1.81	32.8	- 39.0
Tibiale Height	18.1	1.07	16.1	- 19.7
Chest Circumference	38.6	1.90	35.2	- 42.7
Waist Circumference	33.5	2.49	28.4	- 38.9
Buttock Circumference	37.9	1.59	33.5	- 40.9
Acromion-Radiale Length	12.9	3.22	11.3	- 13.9
Radiale-Stylian Length	10.5	0.60	9.2	- 11.7
Sitting Height	36.5	1.35	32.8	- 39.1
Mid-Shoulder Sitting Height	25.5	1.24	22.4	- 27.2
Buttock-Knee Length	24.0	1.14	21.8	- 26.3
Knee Height, Sitting	21.7	1.12	19.3	- 23.5
Head Length	7.8	0.28	7.2	- 8.2
Head Breadth	6.0	0.21	5.7	- 6.5
Head Circumference	22.5	0.65	21.1	- 23.5
Hip Breadth, Sitting	14.5	0.79	12.7	- 15.9

## APPENDIX B

### TEST FACILITIES AND DATA ACQUISITION

Under contract F33615-79-C-0523, Dynalectron Corporation instrumented two test fixtures, a 40 G seat fabricated by Production Design Services, Inc. and a VIP seat fabricated by the 4950th Test Wing, and collected data from a series of human impact tests conducted on the Horizontal Impulse Accelerator and the Vertical Deceleration Tower test facilities. The following describes the test facilities, equipment, and procedures used to acquire and process the test data from these experiments.

#### IMPACT TEST FACILITIES

The horizontal phase of this study was conducted on the Impulse Accelerator. Figure B-1 shows the three major components of this facility: the HYGE actuator, the sled, and the track rails. The energy required to produce the impact acceleration is generated within the HYGE actuator cylinder (Figure B-2) by means of differential gas pressures acting upon a thrust piston. This thrust piston is attached to a thrust column assembly which is used to impact the sled. As pressure moves the thrust assembly, the sled is accelerated from an initial stationary position to a predetermined acceleration level and is then allowed to decelerate by coasting or by brake application. Various acceleration profiles may be obtained by changing the differential pressures, the travel length of the thrust assembly, and the metering structure on the thrust piston. The sled glides along the track rails on twelve glide pads. The sled braking system consists of caliper brakes which grip the track rails when activated by a compressed nitrogen gas power source. The track rails are 1 inch thick and the total track length is 240 feet.

The vertical phase of this study was conducted on the Vertical Deceleration Tower, shown in Figure B-3. The facility consists of a 60 ft high steel tower, which supports a guide rail system, an impact carriage, a hydraulic deceleration device and a test control and safety system. The impact carriage used to carry the test specimen can be raised to a height of up to 42 ft prior to release. After release, the carriage free falls until a plunger attached to the carriage enters a water-filled cylinder mounted at the base of the tower. The deceleration profile produced as the plunger displaces the water in the cylinder is a function of the free fall distance, the carriage and test specimen mass, the shape of the plunger, and the diameter of the cylinder orifice.

#### INSTRUMENTATION

The electronic data collected during this test program included impact sled (or carriage) acceleration and velocity, test fixture loads and acceleration, restraint harness loads, and subject head and chest accelerations. Sled (or carriage) acceleration was measured using three miniature, piezoresistive accelerometers mounted to these structures. The test fixtures were instrumented to measure forces reacted into the seat by the subject. Loads in the restraint system were measured by triaxial load cells located at the restraint harness attachment fittings. Triaxial translational accelerometer arrays were used to measure accelerations on the head and chest of the subject.

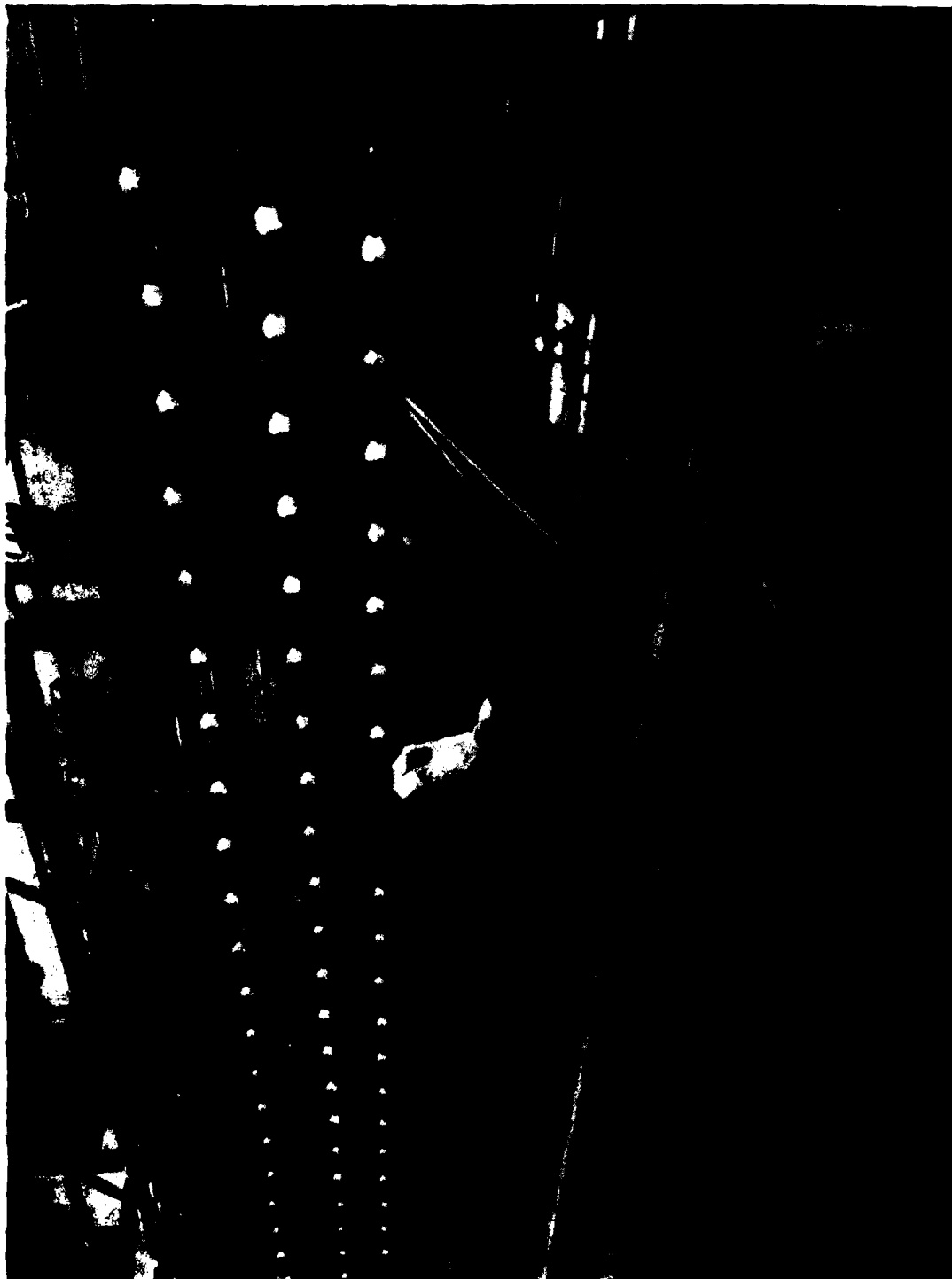


Figure B-1. Horizontal Impulse Accelerator



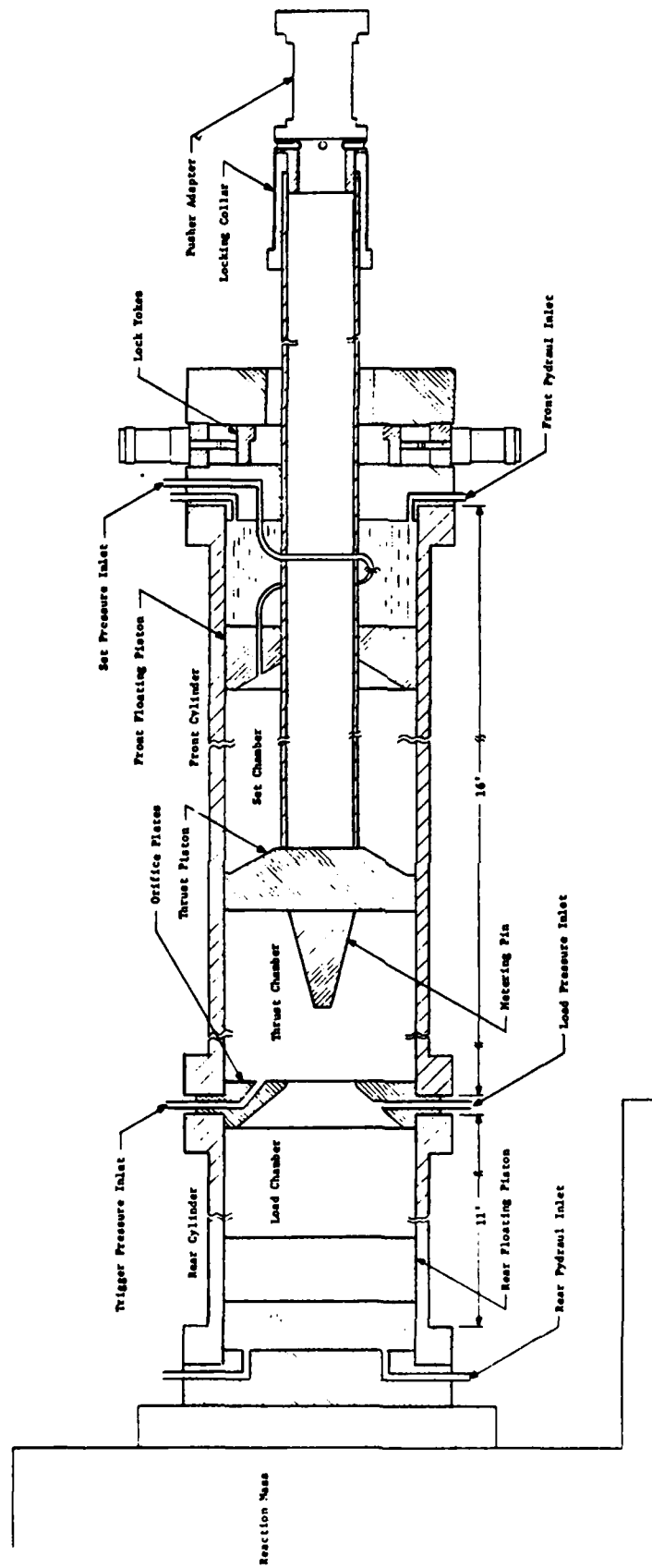


Figure B-2. HYGE Actuator of the Horizontal Impulse Accelerator



Figure B-3. Vertical Deceleration Tower and Test Fixture

The measurement transducers used in the horizontal test phase are listed in Table B-1 and those used in the vertical test phase are shown in Table B-2. These tables designate the manufacturer, type, serial number, sensitivity, and other pertinent data on each transducer used.

Twelve accelerometers were configured in groups of three to create four triaxial measurement packages. Each triaxial package measured accelerations in the X, Y and Z axes. The acceleration coordinate system is shown in Figure B-4. Accelerometers were wired to produce a positive output voltage when accelerations were applied in the +X, +Y or +Z directions, as shown.

The head accelerometer package was designed to be held in the subject's mouth. It consisted of three Endevco Model 2264 accelerometers mounted to a plastic block and covered with medical-grade silicone rubber sealant. This created a small electrically isolated package measuring approximately 9/16 x 9/16 x 1 inch, with three cables extending from the front of the block. The 50-gram accelerometer package was then mounted to a special dental bracket, which was custom fitted for each subject.

The chest accelerometer package consisted of three Endevco Model 2264 accelerometers mounted to a 1/2 x 1/2 x 1/2 inch aluminum block. The block was inserted into an aluminum protective shield to which a length of Velcro fastener strap was attached. The package was placed over the subject's sternum at the level of the xiphoid process and was held there by fastening the Velcro strap around the subject's chest.

The seat accelerometer package consisted of three Endevco Model 2264 accelerometers mounted to a 3/4 x 1 x 1 inch plastic block. The accelerometer package was mounted to the load cell plate beneath the seat, as shown in Figure B-5.

The horizontal sled and vertical carriage accelerometer packages each consisted of two Endevco Model 2264 and one Endevco Model 2262 accelerometers mounted to a 3/4 x 1 x 1 inch block. An aluminum block was used for the sled package and a plastic block was used for the carriage package. The sled accelerometer package was mounted to the undersurface of the sled. The carriage accelerometer package was mounted to the back of the seat fixture, aft of and below the seat.

A Globe Industries tachometer was used to measure sled (or carriage) velocity. An aluminum wheel, with a rubber O-ring around its circumference to assure good rail contact, was attached to the rotor of the tachometer. The wheel contacted the track rail and rotated as the sled (or carriage) moved, producing an output voltage proportional to the velocity.

The seat instrumentation consisted of three load links for measuring loads in the X and Y directions. Two load links measured X axis loads and one measured Y axis loads (Figure B-5). Each load link was instrumented with Micro Measurements strain gages, as shown in Figure B-6. Also, each load link end housed a swivel ball which acted as a coupler between the seat and the load cell mounting plate. The seat load instrumentation and coordinate system for the horizontal test phase (Figure B-7) and for the vertical test phase (Figure B-8) show the locations of the load cells and load links.

DIGITAL INSTRUMENTATION REQUIREMENTS										DYNALLECTRON CORPORATION			
PROGRAM RESTRAINT CONFIGURATION STUDY													
FACILITY HORIZONTAL IMPULSE ACCELERATOR													
DATE 30AUG81										THRU 15AUG82			
RUN 1567										THRU * 2163			
DATA CHANNEL	DATA POINT	EDUCER WAVE TYPE	S/N	REDCER SENS	SCALE V CHAIN	FILTER SERIES	AMP GAIN S/N	SAMPLE RATE S/N	F.S. SENS	FILTER HZ	DOUGER SENS RANGE	BRIDGE BALANCE RESISTORS	SPECIAL NOTATIONS
1	SLED X	Endevco 2262A-200	FR42	4.138 mv/g	10.00 1	60 1	25 10	1K 1	24.2g	120	2.5 / 45.0 -0.0	375K INTO GND	-
2	SLED Y	Endevco 226A-200	B092	2.385 mv/g	10.00 2	60 2	50 5	1K 1	21.0g	120	2.5 / 45.0 -0.0	100K INTO GND	1.63K
3	SLED Z	"	B148	2.653 mv/g	10.00 3	60 3	50 26	1K 1	18.8g	120	2.5 / 45.0 -0.0	254K INTO V10	"
4	HEAD X	"	B010	2.469 mv/g	10.00 4	60 4	25 27	1K 1	40.5g	120	2.5 / 45.0 -0.0	680K INTO GND	1.65K
5	HEAD Y	"	B042	2.689 mv/g	10.00 5	60 5	50 3	1K 1	18.6g	120	2.5 / 45.0 -0.0	114K INTO GND	"
6	HEAD Z	"	B051	2.536 mv/g	10.00 6	60 6	25 22	1K 1	39.4g	120	2.5 / 45.0 -0.0	250K INTO GND	"
7	CHEST X	Endevco 226A-150	BC26	2.773 mv/g	10.00 7	60 7	25 20	1K 1	36.1	120	2.5 / 45.0 -0.0	1.2M INTO GND	"
8	CHEST Y	"	B013	2.404 mv/g	10.00 8	60 8	50 16	1K 1	20.8g	120	2.5 / 45.0 -0.0	305K INTO GND	"
9	CHEST Z	"	2A20	2.600 mv/g	10.00 9	60 9	25 37	1K 1	38.5	120	2.5 / 45.0 -0.0	155K INTO GND	"
10	LEFT SEAT PAH	Strainert PLZ.5 u-251PT	3294-3	8.164 uv/LB	10.00 10	60 10	201 6	1K 1	1523.8	120	2.5 / 45.0 -0.0	-	-
11	RIGHT SEAT PAH	"	3294-5	8.193 uv/LB	10.00 11	60 11	201 7	1K 1	1518.8	120	2.5 / 45.0 -0.0	-	-
12	CENTER SEAT PAH	"	3294-6	8.065 uv/LB	10.00 12	60 12	100 25	1K 1	3100.8	120	2.5 / 45.0 -0.0	-	-
13	LEFT LOAD LINK X	Micro-Trans. EA-06-082TJ-50	2	10.32 uv/LB	10.00 13	60 13	201 3	1K 1	1205.8	120	2.5 / 45.0 -0.0	-	-
14	RIGHT LOAD LINK X	"	3	10.79 uv/LB	10.00 14	60 14	201 5	1K 1	1153.	120	2.5 / 45.0 -0.0	26K INTO GND	-
COMPUTER START: -6 SEC. STOP: +4 SEC.										* TEST NUMBERS: 1987-1990, 1999-2019, 2034-2079, 2089-2162			
										TOP SEAT HEIGHT = 29.5LB(40ECN1)			

Table B-1. Digital Instrumentation Requirements for Horizontal Test Phase

DIGITAL INSTRUMENTATION REQUIREMENTS										DYNALLECTRON CORPORATION				
PROGRAM RESTRAINT CONFIGURATION STUDY										DATE 30 NOV 81 TMRU 190402Z				
FACILITY HORIZONTAL IMPULSE ACCELERATOR										RUN 1987 TMRU 2163				
DATA CHANNEL	DATA POINT	BRIDGE MPG & TYPE	Q/M	BRIDGE BEAM	ELECTRIC V CHAIN	FILTER SERIES	AMP GAIN	SAMPLE RATE	P.S. BEAM	AMPLIFIER ME	BRIDGE ZERO RANGE	BRIDGE BALANCE RESISTORS	BRIDGE COMPLETION RESISTORS	SPECIAL NOTATIONS
15	LEFT LAP LOAD X	GN 30-SM	15X	5.04 uv/LB	10.00 15	60 15	201 8	1K 1	2468LB	120	2.5 +5.0 -0.0	40K +INTO GND	-	
16	LEFT LAP LOAD Y	"	15Y	5.03 uv/LB	10.00 16	60 16	402 4	1K 1	1173LB	120	2.5 +5.0 -0.0	13.7K +INTO GND	-	
17	LEFT LAP LOAD Z	"	15Z	6.24 uv/LB	10.00 17	60 17	201 1	1K 1	1993LB	120	2.5 +5.0 -0.0	15K +INTO GND	-	
18	RIGHT LAP LOAD X	"	21X	4.95 uv/LB	10.00 18	60 18	201 10	1K 1	2513LB	120	2.5 +5.0 -0.0	13.5K +INTO GND	-	
19	RIGHT LAP LOAD Y	"	21Y	4.90 uv/LB	10.00 19	60 19	402 9	1K 1	1269LB	120	2.5 +5.0 -0.0	12K +INTO GND	-	
20	RIGHT LAP LOAD Z	"	21Z	6.06 uv/LB	10.00 20	60 20	201 9	1K 1	2052LB	120	2.5 +5.0 -0.0	90K +INTO GND	-	
21	SHOULDER LOAD X	"	20Z	6.29 uv/LB	10.00 21	60 21	201 4	1K 1	1977LB	120	2.5 +5.0 -0.0	-	-	USE LOAD CELL 2 AXIS CAL
22	SHOULDER LOAD Y	"	20Y	5.46 uv/LB	10.00 22	60 22	402 13	1K 1	1139LB	120	2.5 +5.0 -0.0	800K +INTO GND	-	
23	SHOULDER LOAD Z	"	20X	5.11 uv/LB	10.00 23	60 23	201 11	1K 1	2434LB	120	2.5 +5.0 -0.0	160K +INTO GND	-	USE LOAD CELL X AXIS CAL
24	SEAT X	Endevco 2284-200	BV95	2.967 mv/g	10.00 24	60 24	50 27	1K 1	16.99	120	2.5 +5.0 -0.0	-	1.47K	
25	SEAT Y	"	BV56	2.743 mv/g	10.00 25	60 25	50 14	1K 1	18.29	120	2.5 +5.0 -0.0	125K +INTO GND	1.47K	
26	SEAT Z	"	BV71	2.874 mv/g	10.00 26	60 26	50 20	1K 1	17.49	120	2.5 +5.0 -0.0	512K +INTO GND	1.63K	
27	CENTER LOAD 1 INK	Micro-Meas. 1A-05-062 1A-150	5	9.98 uv/LB	10.00 27	60 27	402 5	1K 1	623LB	120	2.5 +5.0 -0.0	82K +INTO GND	-	
29	VELOCITY	Globe 224672	2	2.664 V/IPS 10.25	- 29	60 29	1 1	1K 1	117.2 FT/SEC	120	0 +5.0 -0.0	-	-	6.24Z ATTENUATOR LOCATED IN SIG COND. SENS = .2644VOLT FPS .04268 V/FPS ATTEN 6.24Z POSITIVE OUTPUT
30	K-6 STRAINER STAMP	Strainser FLU-25G	237	19.81 uv/LB	10.00 30	60 30	201 12	1K 1	628LB	120	2.5 +5.0 -0.0	-	-	Test 2036-2054 M-H Strain Gage 20; Sens. 25.12 uv/LB; F.S. 495 LB
37	EVENT	"	-	-	- 37	1000 30	2.5 9	1K 1	2.5 Volts	2000	2.5 +5.0 -0.0	-	-	Event is negative going
47	2.5 VOLT BIAS	"	-	-	- 47	180 14	1 1	1K 1	2.5 Volts	360	2.5 +5.0 -0.0	-	-	
48	10 VOLT ETC.	"	-	-	10.00 48	180 27	1 1	1K 1	5.0 Volts	360	5.0 +5.0 -0.0	-	-	

DIGITAL INSTRUMENTATION REQUIREMENTS										DYNALLECTRON CORPORATION									
PROGRAM RESTRAINT CONFIGURATION STUDY -G2										DATE 13 APR 82 THRU 22 JUL 82									
FACTORY VERTICAL DECELERATION TOWER										RUN 596 THRU 725									
DATA CHANNEL	DATA POINT	ROCKER MFG & TYPE	%/M	ROCKER BEAMS	EXCITE V CHAIN	FILTER SERIES	FILTER NAME S/M	AMP NAME S/M	SAMPLE RATE FORMAT	P.B. BEING	FILTER Hz	ROCKER ZERO RANGE	BRIDGE BALANCE RESISTORS	BRIDGE COMPLETION RESISTORS	SPECIAL NOTATIONS				
1	CARRIAGE X	ENDEVCO 2264-200	B149	2.580 mv/g	10.00	1	60 1	100 2	1K 1	9.69g	120	2.5 +5.0 -0.0	200K +INTO GND	1.63K					
2	CARRIAGE Y	ENDEVCO 2264-150	B811	2.374 mv/g	10.00	2	60 2	100 16	1K 1	10.53g	120	2.5 +5.0 -0.0	120K -INTO GND	1.63K					
3	CARRIAGE Z	ENDEVCO 2262A-200	F842	4.129 mv/g	10.00	3	60 3	25 37	1K 1	24.22g	120	2.5 +5.0 -0.0	---	---					
4	HEAD X	ENDEVCO 2264-200	BP10	2.479 mv/g	10.00	4	60 4	50 3	1K 1	20.17g	120	2.5 +5.0 -0.0	680K -INTO GND	1.65K					
5	HEAD Y	"	BQ42	2.704 mv/g	10.00	5	60 5	50 29	1K 1	18.5g	120	2.5 +5.0 -0.0	114K +INTO GND	"					
6	HEAD Z	"	BQ51	2.554 mv/g	10.00	6	60 6	25 10	1K 1	39.15g	120	2.5 +5.0 -0.0	250K -INTO GND	"					
7	CHEST X	ENDEVCO 2264-150	BC26	2.795 mv/g	10.00	7	60 7	50 5	1K 1	17.89g	120	2.5 +5.0 -0.0	1.2M -INTO GND	"					
8	CHEST Y	ENDEVCO 2264-150	BB13	2.414 mv/g	10.00	8	60 8	100 19	1K 1	10.36g	120	2.5 +5.0 -0.0	305K +INTO GND	"					
9	CHEST Z	"	2A20	2.615 mv/g	10.00	9	60 9	25 27	1K 1	38.24g	120	2.5 +5.0 -0.0	155K -INTO GND	"					
10	LEFT SEAT PAN	STRATH-SEAT FL2 Su-250PT	3294-3	8.164 uv/LB	10.00	10	60 10	201 3	1K 1	1523LB	120	2.5 +5.0 -0.0	---	---					
11	RIGHT SEAT PAN	"	3294-5	8.193 uv/LB	10.00	11	60 11	201 7	1K 1	1518LB	120	2.5 +5.0 -0.0	---	---					
12	CENTER SEAT PAN	"	3294-6	8.065 uv/LB	10.00	12	60 12	201 8	1K 1	1542LB	120	2.5 +5.0 -0.0	---	---					
13	LEFT LOAD LINK X	M-H EA-19-158	2	10.20 uv/LB	10.00	13	60 13	402 4	1K 1	609.7LB	120	2.5 +5.0 -0.0	---	---					
14	RIGHT LOAD LINK X	"	3	10.63 uv/LB	10.00	14	60 14	402 9	1K 1	585.0LB	120	2.5 +5.0 -0.0	26K -INTO GND	---					
COMPUTER START: - 6 SEC. STOP: + 3 SEC.										M-G STRAP TESTS: 627, 634, 638, 644, 651, 652, 655, 656, 661, 662, 663, 664, 672, 673, 675, 678, 679, 686, 687, 688, 690, 696, 698, 699, 697, 701, 703, 704, 705, 714, 715, 716, 717, 723, 725									
										9g TESTS: 8.0 FT HEIGHT 10g TESTS: 11.0 FT HEIGHT									

Table B-2. Digital Instrumentation Requirements for Vertical Test Phase

DIGITAL INSTRUMENTATION REQUIREMENTS										DYNALLECTRON CORPORATION					
PROGRAM RESTRAINT CONFIGURATION STUDY -G-										DATE 11 APR 82 168U 22 JUL 82					
FACILITY VERTICAL ACCELERATION TOWER										RUN 596 725					
DATA CHANNEL	DATA POINT	INCHER MAP & TYPE	WPM	INCHER BEAM	ERGITE V CHAN	FILTER SECT	AMP GAIN	AMP S/N	SAMPLE RATE	P.A. SENS	PAPER IN	SENDER ZERO RANGE	BRIDGE BALANCE RESISTORS	BRIDGE COMPLETION RESISTORS	SPECIAL NOTATIONS
15	LEFT LAP LOAD 1	GN 30-SM	15X	4.99 uv/LB	10.00 15	60 15	402 1	402 1	1K 1	12461.8	120	2.5 +5.0 -0.0	60K +INTO GND	-	
16	LEFT LAP LOAD 1	"	15Y	5.30 uv/LB	10.00 16	60 16	800 1	800 1	1K 1	5901.8	120	2.5 +5.0 -0.0	16K +INTO GND	-	
17	LEFT LAP LOAD 2	"	15Z	6.14 uv/LB	10.00 17	60 17	402 3	402 3	1K 1	10131.8	120	2.5 +5.0 -0.0	28K +INTO GND	-	
19	RIGHT LAP LOAD 1	"	21X	4.87 uv/LB	10.00 18	60 18	402 5	402 5	1K 1	12771.8	120	2.5 +5.0 -0.0	13.5K +INTO GND	-	
19	RIGHT LAP LOAD 1	"	21Y	4.82 uv/LB	10.00 19	60 19	800 2	800 2	1K 1	6481.8	120	2.5 +5.0 -0.0	11K +INTO GND	-	
20	RIGHT LAP LOAD 2	"	21Z	5.96 uv/LB	10.00 20	60 20	402 6	402 6	1K 1	10431.8	120	2.5 +5.0 -0.0	90K +INTO GND	-	
21	SHOULDER LOAD 1	"	20Z	6.22 uv/LB	10.00 21	60 21	402 7	402 7	1K 1	10001.8	120	2.5 +5.0 -0.0	48K +INTO GND	-	USE LOAD CELL 2 AXIS CAL.
22	SHOULDER LOAD 1	"	20Y	5.37 uv/LB	10.00 22	60 22	800 3	800 3	1K 1	5821.8	120	2.5 +5.0 -0.0	800K +INTO GND	-	
23	SHOULDER LOAD 2	"	20X	5.02 uv/LB	10.00 23	60 23	402 10	402 10	1K 1	12391.8	120	2.5 +5.0 -0.0	77K +INTO GND	-	
24	SEAT 1	ENCYCO 2264-200	BV95	2.962 mv/g	10.00 24	60 24	50 27	50 27	1K 1	16.88g	120	2.5 +5.0 -0.0	-	1.47K	
25	SEAT 1	"	BV56	2.749 mv/g	10.00 25	60 25	100 21	100 21	1K 1	18.19g	120	2.5 +5.0 -0.0	125K +INTO GND	-	
26	SEAT 2	"	BW71	2.889 mv/g	10.00 26	60 26	50 26	50 26	1K 1	17.32g	120	2.5 +5.0 -0.0	512K +INTO GND	1.63K	
27	CENTER LOAD LINK Y	M-N EA-08-06C 1A-350	5	9.79 uv/LB	10.00 27	60 27	402 2	402 2	1K 1	6351.8	120	2.5 +5.0 -0.0	82K +INTO GND	-	
29	VELOCITY	GLOBE 226672	3	.5019 VOLTS/EPS	- 29	60 28	1 29	1 29	1K 1	2.5VOLT/31.1FPS	120	2.5 +5.0 -0.0	-	-	SIGNAL ATTENUATED BY 6.242 PRIOR TO SIG. COND. AMPLIFIER-REG OUTPUT SEPS. 0.5019/6.242= 0.0804 VOLTS/EPS
30	M-G STOP	STAIN-SEPT FLUO 25G	207	19.81 uv/LB	10.00 30	60 30	201 11	201 11	1K 1	6281.8	120	2.5 +5.0 -0.0	-	-	
37	EVENT	"	"	"	- 37	1000 30	2.5 9	2.5 9	1K 1	2.5 VOLT	2000	2.5 +5.0 -0.0	-	-	NEGATIVE PULSE
47	2.5 VOLT BIAS	"	"	"	- 47	180 14	1 14	1 14	1K 1	2.5 VOLT	360	2.5 +5.0 -0.0	-	-	
48	10 VOLT ETC.	"	"	"	- 48	180 27	1 27	1 27	1K 1	2.5 VOLT	360	5.0 +5.0 -0.0	-	-	TEST 596-693 CHANNEL 48 DIVIDED BY 2. TEST 694 AND SUBSEQUENT DIVIDE BY 4

Table B-2. Digital Instrumentation Requirements for Vertical Test Phase (continued)

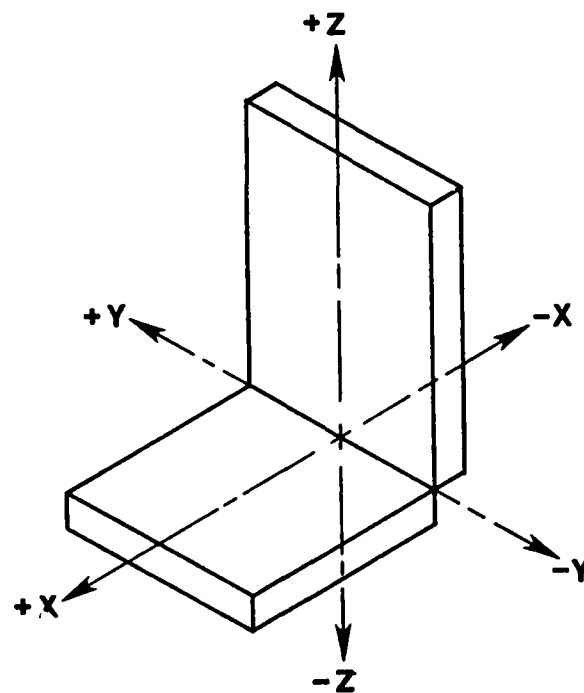


Figure B-4. Accelerometer Coordinate System

Seven load cells were required to instrument each test fixture. Three triaxial GM load cells were used to measure the shoulder strap load and the right and left lap belt loads. The negative G strap was attached to a Strainsert load cell. Three Strainsert load cells were used to measure the center, left, and right seat loads in the Z axis.

Pre-program and post-program calibrations were made to check the accuracy of the data measuring transducers. The calibration of all Strainsert load cells was performed by the Precision Measurements Equipment Laboratories (PMEL), Wright-Patterson Air Force Base. PMEL calibrated these devices on a periodic basis and provided current sensitivity and linearity data.

The load links and GM load cells were calibrated by Dynalelectron Corporation. These transducers were calibrated to a laboratory standard load cell in a special test fixture. The sensitivity and linearity of each test load cell were obtained by comparing the output of the test load cell to the output of the laboratory standard under identical loading conditions. The laboratory standard load cell, in turn, is calibrated by PMEL on a periodic basis.

The calibration of the accelerometers was performed by Dynalelectron Corporation using the reciprocity method (Ensor, 1970). A laboratory standard accelerometer, calibrated on a yearly basis by Endevco with standards traceable to the National Bureau of Standards, and a test accelerometer were mounted on a shaker table. The frequency response and phase shift of the test accelerometer were determined



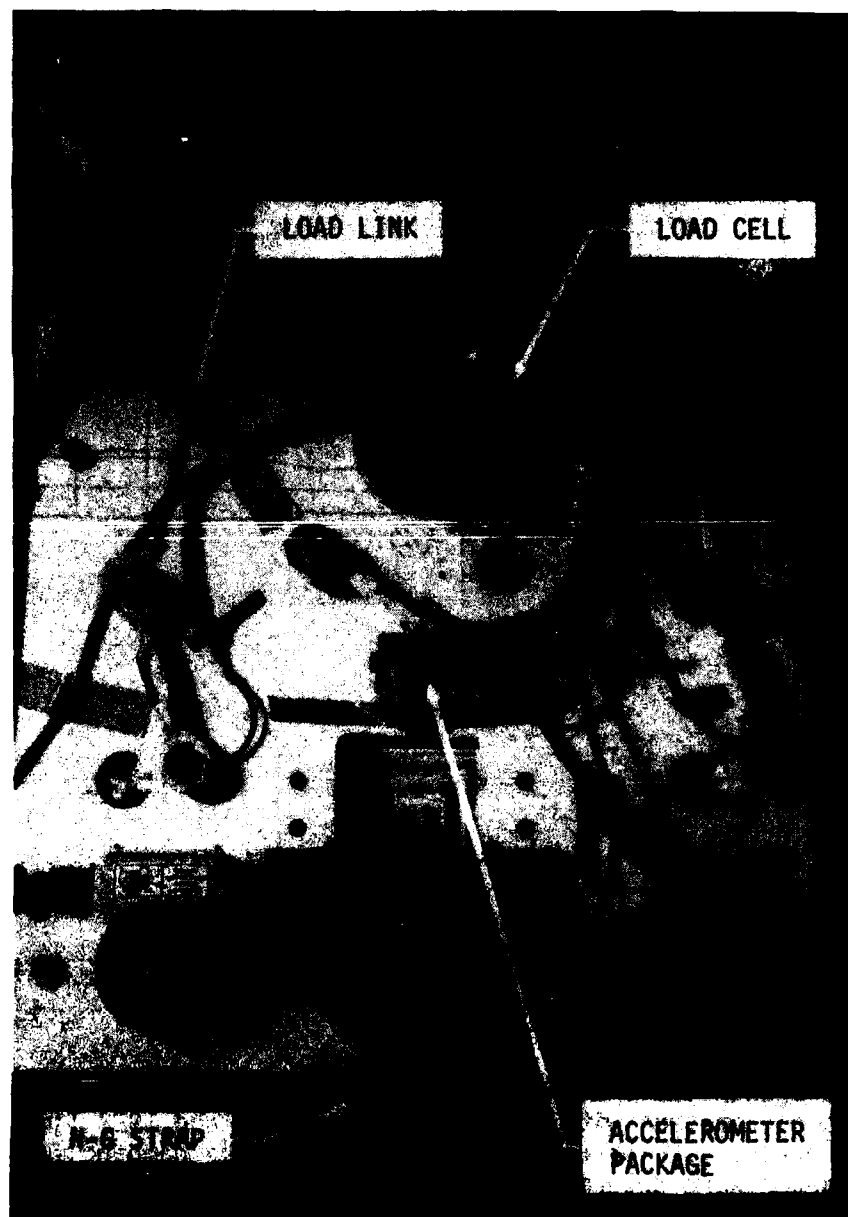


Figure B-5. Seat Pan Instrumentation

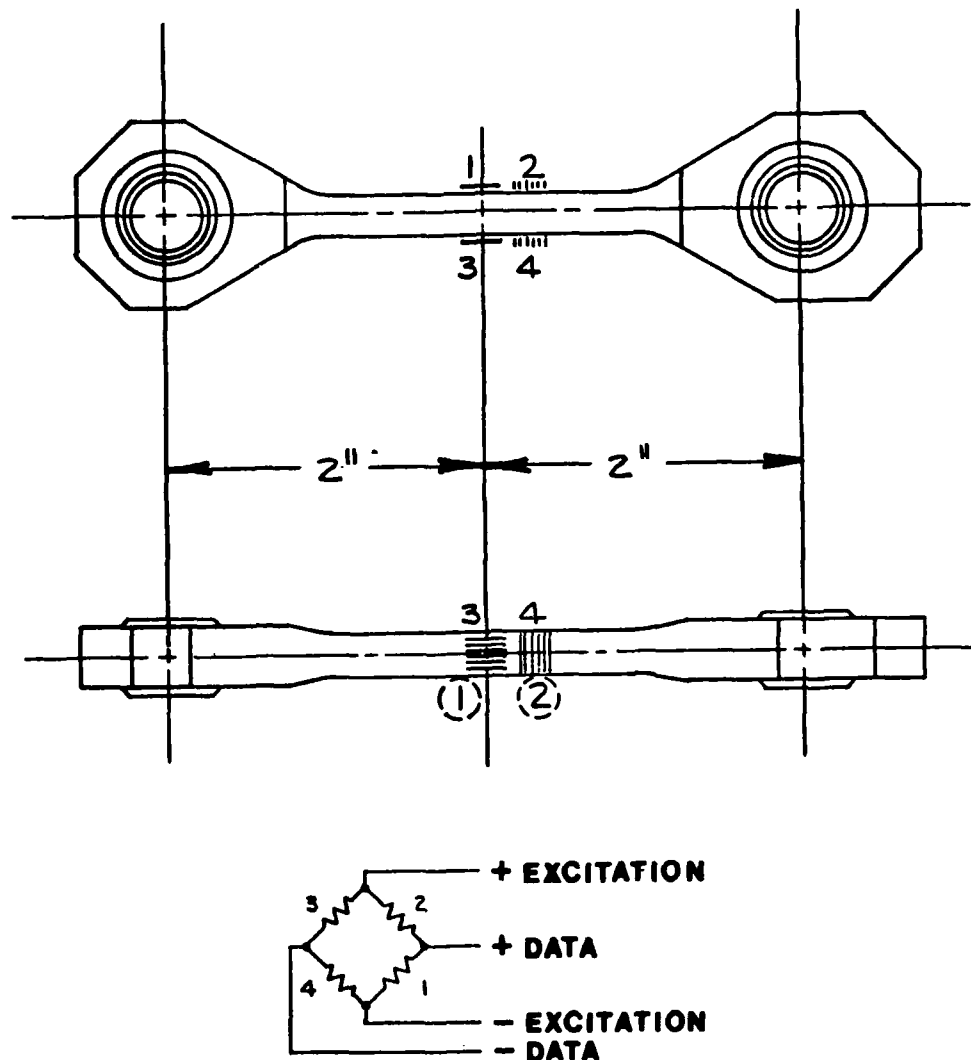


Figure B-6. Load Link Instrumentation

by driving the shaker table with a random noise generator and analyzing the outputs of the accelerometers with a PDP 11/15 computer and 1923 Time Data Unit using Fourier analysis. The natural frequency and the damping factor of the test accelerometer were determined, recorded, and compared to previous calibration data for that test accelerometer. Calibrations were made at 40 G and 100 Hertz. The sensitivity of the test accelerometer was determined by comparing its output to the output of the laboratory standard accelerometer.

The velocity wheel was calibrated by rotating the wheel at various revolutions per minute (RPM) and recording both the output voltage and the RPM. The sensitivity was dynamically checked with a G-HI measuring system. This system consists of a timing unit and an optical sensor mounted near the track rails. As the sled (or carriage) travels along the track rails, a metal blade on the sled (or carriage) interrupts the optical sensor beam. The timing unit displays a time which may be correlated to a velocity.

Point No.	Axis [Inches (Centimeters)]		
	X	Y	Z
Center Reference	1 (0)	0 (0)	0 (0)
Load Cell	2 -4.88 (-12.40)	0 (0)	-2.46 (-6.24)
Load Cell	3 -16.18 -41.10	-5.02 (-12.75)	-2.46 (-6.24)
Load Cell	4 -16.18 (-41.10)	+5.02 (+12.75)	-2.46 (-6.24)
Load Cell	5 -14.96 (-38.00)	0 (0)	-3.39 (-8.62)
Triaxial Load Cell	6 +1.57 (+4.00)	+9.00 (+22.86)	-1.77 (-4.50)
Triaxial Load Cell	7 +1.57 (+4.00)	-9.00 (-22.86)	-1.77 (-4.50)
Triaxial Load Cell	8 +11.83 (+30.00)	0 (0)	+26.78 (+68.00)
Load Link	9 -7.44 (-18.90)	-2.07 (-5.25)	-3.05 (-7.74)
Load Link	10 -8.23 (-20.90)	+6.00 (+15.25)	-3.05 (-7.74)
Load Link	11 -8.23 (-20.90)	-6.00 (-15.25)	-3.05 (-7.74)

• Rotating in XZ Plane

LOAD CELL 5 PROVIDES A POSITIVE (+) OUTPUT VOLTAGE WHEN THE H-4 STRAP IS PULLED IN THE +Z DIRECTION.

TRIAxIAL LOAD CELL 8 PROVIDES A POSITIVE (+) OUTPUT VOLTAGE FOR X, Y AND Z WHEN THE HARNESS IS PULLED IN THE +X, -Y AND -Z DIRECTIONS RESPECTIVELY.

TRIAxIAL LOAD CELLS 6, 7 PROVIDE A POSITIVE (+) OUTPUT VOLTAGE WHEN THE HARNESS IS PULLED TOWARDS THE CENTER REFERENCE.

LOAD CELLS 2, 3, 4 AND LOAD LINKS 9, 10, 11 PROVIDE A POSITIVE (+) OUTPUT VOLTAGE WHEN PRESSURE IS APPLIED TO THE SEAT PAN AS SHOWN BELOW.

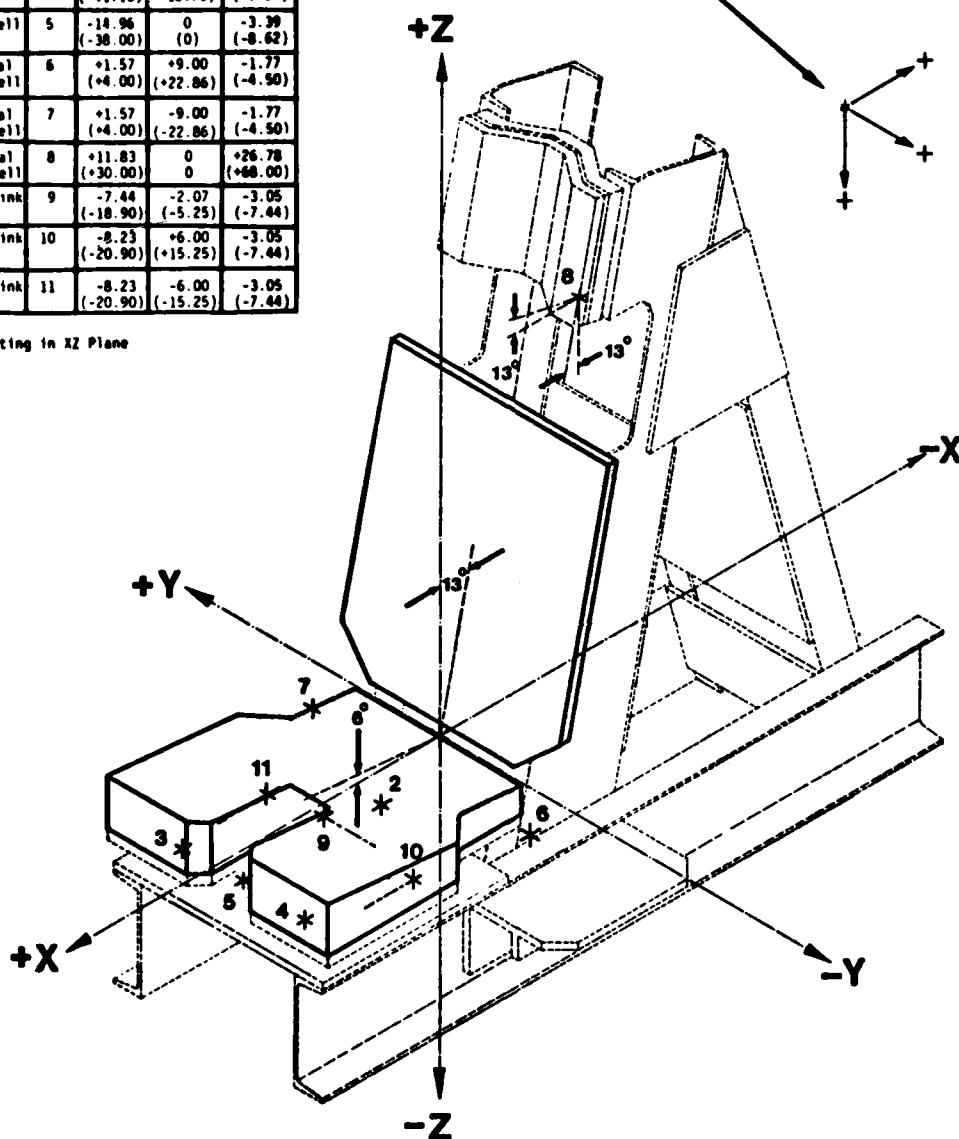


Figure B-7. Seat Load Instrumentation Coordinate System for the Horizontal Test Phase

Point No.	Axis Positions Inches (Centimeters)		
	X	Y	Z
Center Reference	1 0 (0)	0 (0)	0 (0)
Load Cell	2 +4.625 (+11.748)	0 (0)	-3.125 (-7.938)
Load Cell	3 +16.000 (+40.640)	+7.000 (+17.780)	-3.125 (-7.938)
Load Cell	4 +16.000 (+40.640)	-7.000 (-17.780)	-3.125 (-7.938)
Load Cell	5 +15.000 (+38.100)	0 (0)	-0.594 (-1.508)
Triaxial Load Cell	6 -1.500 (-3.810)	-9.000 (-22.860)	-1.688 (-4.286)
Triaxial Load Cell	7 -1.500 (-3.810)	+9.000 (+22.860)	-1.688 (-4.286)
Triaxial Load Cell	8 -5.775 (-14.669)	0 (0)	+27.625 (+70.168)
Load Link	9 +7.000 (+17.780)	+2.000 (+5.080)	-3.719 (-9.446)
Load Link	10 +8.000 (+20.320)	+5.000 (+12.700)	-3.719 (-9.446)
Load Link	11 +8.000 (+20.320)	-5.000 (-12.700)	-3.719 (-9.446)

\* Pivoting in the XZ Plane

LOAD CELL 5 PROVIDES A POSITIVE (+) OUTPUT VOLTAGE WHEN THE H-6 STRAP IS PULLED IN THE +Z DIRECTION.

TRIAXIAL LOAD CELL 8 PROVIDES A POSITIVE (+) OUTPUT VOLTAGE FOR X, Y AND Z WHEN THE HARNESS IS PULLED IN THE +X, -Y AND -Z DIRECTIONS RESPECTIVELY.

TRIAXIAL LOAD CELLS 6, 7 PROVIDE A POSITIVE (+) OUTPUT VOLTAGE WHEN THE HARNESS IS PULLED TOWARDS THE CENTER REFERENCE.

LOAD CELLS 2, 3, 4 AND LOAD LINKS 9, 10, 11 PROVIDE A POSITIVE (+) OUTPUT VOLTAGE WHEN PRESSURE IS APPLIED TO THE SEAT PAN AS SHOWN BELOW.

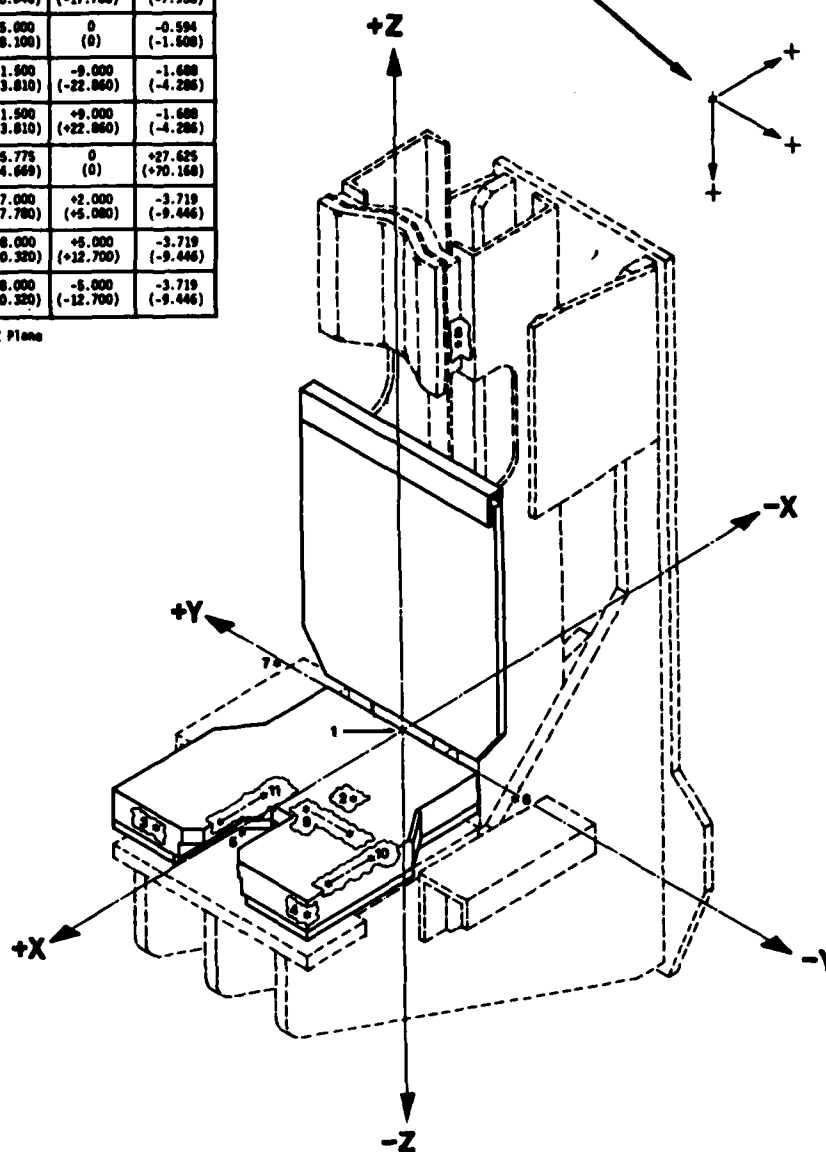


Figure B-8. Seat Load Instrumentation Coordinate System for the Vertical Test Phase

## AUTOMATIC DATA ACQUISITION AND CONTROL SYSTEM (ADACS)

The ADACS, which was mounted to the sled (or carriage), consists of three major components: the power conditioner, the signal conditioner, and the encoder. The operation of the ADACS is outlined in Figure B-9. The power conditioner receives 28 VDC via the whip cable and provides six regulator voltages. The signal conditioner contains 48 modules capable of processing sensor data. Each module has an amplifier and filter section. Each amplifier can be programmed for one of seven gains by means of external gain plugs. Each filter can be programmed for one of four filter frequencies by means of external filter plugs.

Each module provides +5 and +10 VDC for transducer excitation and +2.5 VDC for output signal offset, if necessary. Bridge completion and balance resistors can be added to the module input connector, if necessary. The 48 module output signals are digitized via the Pulse Code Modulation (PCM) encoder into 48 11-bit digital words. Two additional 11-bit synchronization (sync) words are added to the data frame. This 50-word data frame is then sampled at a rate of 1000 samples per second. Three synchronization pulse trains (bit sync, word sync and frame sync) are added to the word frame and sent to the computer via the junction box and whip cable.

The PDP 11/34 mini-computer receives serial data from the ADACS. The serial data coming from the sled (or carriage) are converted to parallel data in the data formatter. The data formatter deposits data into the computer memory via the buffered data channel where data are stored on disk temporarily and later are transferred to magnetic tape for permanent storage. The interrelationships among the data acquisition and storage equipment are shown in Figure B-10.

Test data could be reviewed immediately after each test by using the "Quick Look" CHAN routine. CHAN may be used to produce a plot of the data stored on any channel as a function of time. The routine determines the minimum and maximum values of any data plot. It may also be used to calculate velocity by integrating sled (or carriage) acceleration.

The effect of seat pan mass was accounted for by performing a series of tare tests (no subject) and determining the percentage of seat pan load on each load transducer. For human tests, this percentage was multiplied by the product of the seat pan mass and acceleration. The resultant value was then subtracted from the dynamically acquired test data to reflect actual subject loads.

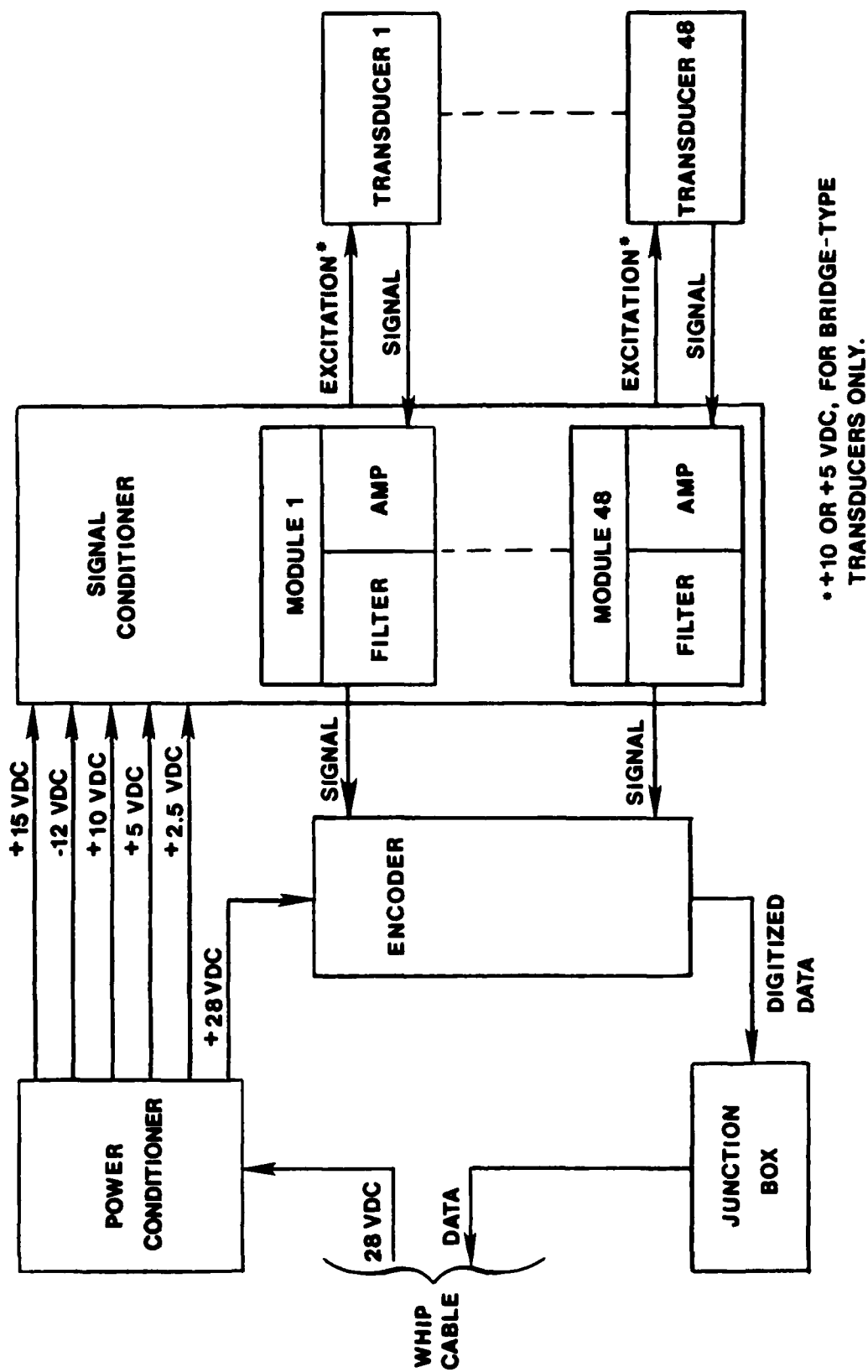


Figure B-9. Automatic Data Acquisition and Control System

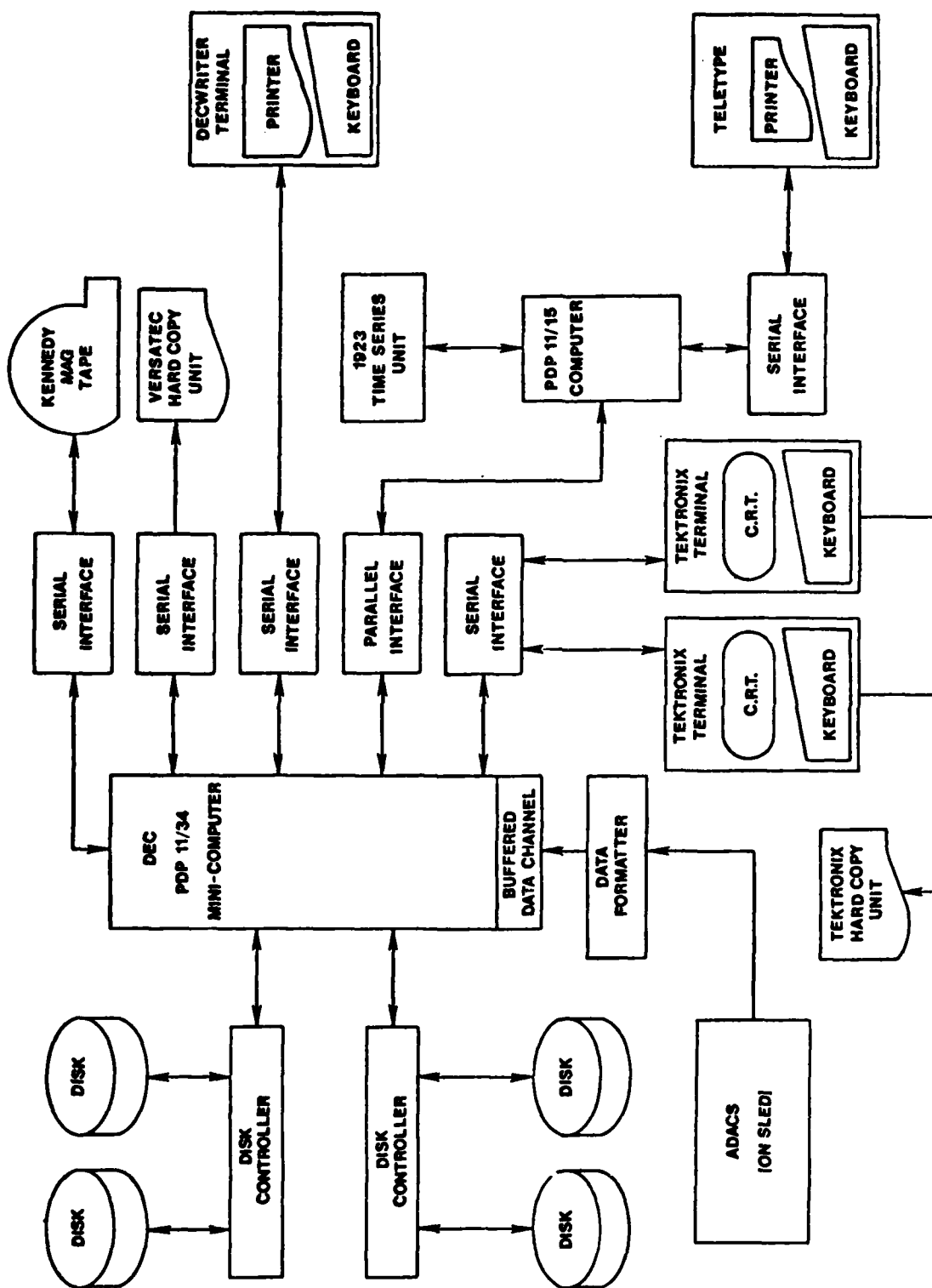


Figure B-10. Data Acquisition and Storage

## PHOTOMETRIC DATA ACQUISITION SYSTEM

Two high-speed 16 mm cameras (Teledyne Milliken, Model DBM45), operating at 500 frames per second, were used to produce the photometric data. These units were hardened to withstand a 25 G impact. The cameras were mounted on the sled (or carriage) to provide adequate coverage of the subject during the impact. The cameras were automatically started at a preset time in the test sequence by a signal from the Camera and Lighting Control Station.

Motion of the subject's head, shoulders, arms, legs, and chest were quantified by tracking the motion of subject-mounted fiducials. Reference fiducials were placed on the test fixture. The fiducial consisted of a 3/4 inch diameter black circle printed on a 1 1/4 inch diameter white target. The locations of the fiducials generally followed the guidelines provided in "Film Analysis Guides for Dynamic Studies of Test Subjects, Recommended Practice" (SAE J138, March 1980).

The photometric data were time correlated with the impact event. Immediately prior to impact, an event signal triggered the flash unit to mark the camera film frame. At that time, a 100 PPS signal activated the Camera L.E.D. Driver which pulsed the camera L.E.D., producing a time mark at the film edge. This reference mark was then used to correlate the photometric data with the electronically measured data.

The photometric data were processed on the Automatic Film Reader (AFR) system, shown schematically in Figure B-11. The fiducial tracking routine is initiated via the Data General terminal. The tracking routine is booted from a floppy disk into the Nova 3/12 memory. The system is capable of tracking fiducials manually or automatically. The Nova 3/12 outputs an X-Y film coordinate position to magnetic tape for each fiducial being tracked. Data are then transferred from magnetic tape to the DEC PDP 11/34 disk file. The disk file is then reformatted for CDC Cyber 74 compatibility and written to another magnetic tape.

An Instant Analytical Replay (INSTAR) video system was also used to provide photometric coverage of each experiment. This video recorder and display unit is capable of recording high-speed motion at a rate of 120 frames per second. Immediate replay of the impact is possible in real time or in slow motion.



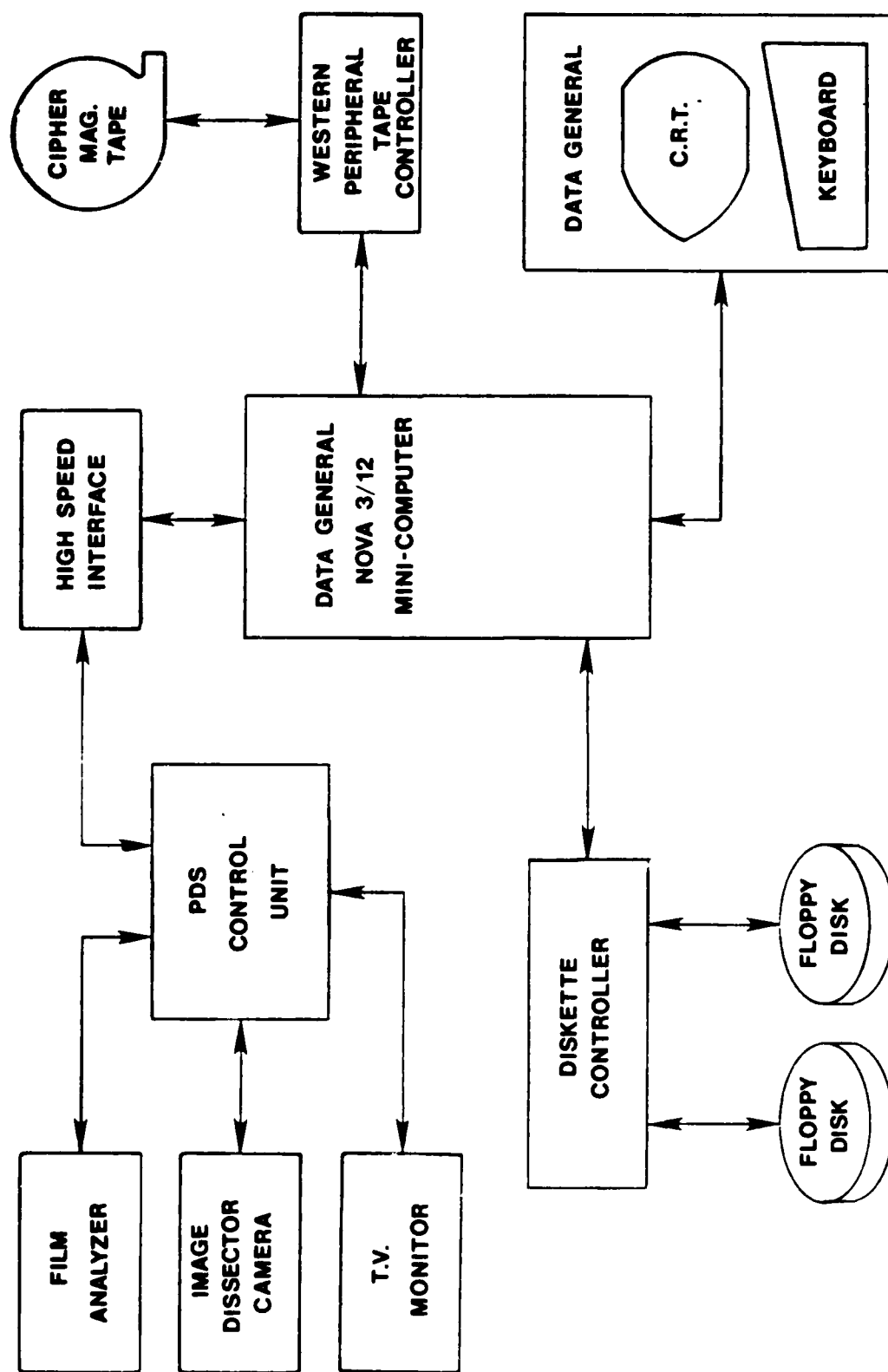


Figure B-11. Automatic Film Reader

## APPENDIX C

### SUMMARY OF ELECTRONIC DATA

Means and estimated standard deviations of all measured and computed response parameters in each test condition are presented in this appendix. Data from the horizontal test phase are shown in Table C-1 and data from the vertical test phase are shown in Table C-2.

An individual data summary for each experimental level test is also provided. On each individual summary, the test phase and number, the subject identification code and weight, and the test condition or cell are identified. The impact maximum and impact minimum values of each response parameter are specified. The corresponding times at which these values occurred are also given in milliseconds.

All times may be referenced to the impact start time. During the horizontal test phase, the impact start time was defined as the time at which the sled acceleration exceeded 0.5 G and remained above 0.5 G for at least 5 consecutive msec subsequent to that time. During the vertical phase, the impact start time was defined as the time at which the largest negative carriage velocity (minimum) occurred. In addition, a time known as the "reference mark" was used to synchronize the electronic and photometric data.

Pre-impact load data are also presented. For the horizontal tests, a pre-impact average of these values taken over the 25 milliseconds immediately preceding the impact is given. For the vertical tests, a maximum value of the parameter occurring during carriage free fall and the corresponding time that value occurred are given. These served as baseline values for analysis of the data collected during the impact.

The smoothed sled (and carriage) acceleration was obtained using a point moving average method. Sled (and carriage) velocity was measured by tachometer and was also computed by integrating the sled (and carriage) acceleration. Head and chest Severity Indices were calculated using the method described by Gadd (1966).

Component strap loads were measured at the strap attachment fitting. Resultant loads were obtained by continuously summing load components. Total lap belt load was obtained by summing the right and left resultant lap belt loads. For the vertical tests, vertical seat loads were corrected for tare load.

In addition, a typical set of graphic data from each test condition is presented. To permit comparability among these data, test results of the same subject are shown in each test condition.

The electronic data from this study will be stored on magnetic tape in the Biomechanical Protection Branch until this work unit is retired. Ultimately, these data may be recorded in a permanent biodynamic data base within AFAMRL.

TABLE C-1  
MEANS AND STANDARD DEVIATIONS OF  
ELECTRONICALLY MEASURED AND COMPUTED DATA  
FROM HORIZONTAL TEST PHASE

(PEAK VALUES ARE TABULATED FOR VELOCITY, ACCELERATIONS AND LOADS.)

TEST CONDITION  
RESTRAINT HARNESS  
NEGATIVE G STRAP

A  
PCU-15/P  
NO

(N = 16)

B  
PCU-15/P  
YES

(N = 15)

	MEAN	ST DEV	MEAN	ST DEV
SLED X ACCELERATION (G)	-9.50	0.10	-9.50	0.09
SLED VELOCITY (FT/SEC)	-30.2	0.20	-30.1	0.21
SEAT X ACCELERATION (G)	-9.92	0.13	-9.94	0.10
CHEST ACCELERATION (G)				
-X AXIS	-20.8	5.19	-22.2	4.89
+Z AXIS	15.3	3.91	16.1	4.82
RESULTANT	24.6	4.94	25.8	5.16
CHEST SEVERITY INDEX	66.5	17.4	71.1	19.2
HEAD ACCELERATION (G)				
-X AXIS	-13.6	2.65	-13.2	3.23
-Z AXIS	-12.0	4.17	-11.0	5.07
RESULTANT	17.5	4.13	16.7	4.30
HEAD SEVERITY INDEX	63.7	15.7	55.3	17.4
STRAP LOAD (LB)				
TOTAL SHOULDER STRAPS	675	115	700	91
TOTAL LAP BELT	1930	276	2080	348
NEGATIVE G STRAP			136	50
VERTICAL SEAT LOAD (LB)	1490	232	1530	279

TEST CONDITION  
RESTRAINT HARNESS  
NEGATIVE G STRAP

C  
CONVENTIONAL  
NO

(N = 18)

D  
CONVENTIONAL  
YES

(N = 18)

	MEAN	ST DEV	MEAN	ST DEV
SLED X ACCELERATION (G)	-9.47	0.08	-9.46	0.07
SLED VELOCITY* (FT/SEC)	-30.2	0.17	-30.2	0.16
SEAT X ACCELERATION (G)	-9.90	0.11	-9.89	0.06
CHEST ACCELERATION (G)				
-X AXIS	-13.0	1.13	-16.2	2.36
+Z AXIS	11.1	4.63	9.78	2.27
RESULTANT	16.1	2.23	17.3	2.14
CHEST SEVERITY INDEX	36.8	8.51	42.3	7.12
HEAD ACCELERATION (G)				
-X AXIS	-14.3	2.81	-14.4	3.75
-Z AXIS	-9.26	4.05	-11.2	5.54
RESULTANT	16.7	3.59	17.8	5.42
HEAD SEVERITY INDEX	55.8	20.4	60.8	22.8
STRAP LOAD (LB)				
TOTAL SHOULDER STRAPS	621	101	728	125
TOTAL LAP BELT	1690	205	1860	280
NEGATIVE G STRAP			218	78
VERTICAL SEAT LOAD (LB)	1340	200	1530	303

TABLE C-2

MEANS AND STANDARD DEVIATIONS OF  
ELECTRONICALLY MEASURED AND COMPUTED DATA  
FROM VERTICAL TEST PHASE

(PEAK VALUES ARE TABULATED FOR VELOCITY, ACCELERATIONS AND LOADS.)

TEST CONDITION  
RESTRAINT HARNESS  
NEGATIVE G STRAP

E  
PCU-15/P  
NO

(N = 16)

F  
PCU-15/P  
YES

(N = 17)

	MEAN	ST DEV	MEAN	ST DEV
CARRIAGE Z ACCELERATION (G)	9.93	0.05	9.94	0.07
CARRIAGE VELOCITY (FT/SEC)	-26.2	0.11	-26.3	0.13
SEAT Z ACCELERATION (G)	10.9	0.15	10.9	0.20
CHEST ACCELERATION (G)				
-X AXIS	-1.10	0.75	-1.00	0.58
+X AXIS	2.51	1.55	2.49	1.35
+Z AXIS	19.5	2.20	18.7	2.50
RESULTANT	19.8	2.11	19.0	2.47
CHEST SEVERITY INDEX	37.3	4.48	35.4	4.73
HEAD ACCELERATION (G)				
-X AXIS	-1.18	0.94	-1.25	0.88
+X AXIS	3.29	1.49	2.98	1.60
+Z AXIS	12.8	1.37	12.5	0.93
RESULTANT	13.3	1.24	13.0	0.89
HEAD SEVERITY INDEX	23.3	1.98	22.0	1.92
FREE FALL STRAP LOADS (LB)				
TOTAL SHOULDER STRAP	66	23	75	30
TOTAL LAP BELT	264	66	247	66
NEGATIVE G STRAP			80	32
IMPACT STRAP LOADS (LB)				
TOTAL SHOULDER STRAPS	108	30	108	31
TOTAL LAP BELTS	110	41	90	28
NEGATIVE G STRAP			41	17
FREE FALL SEAT LOADS (LB)				
+Z AXIS	243	49	281	70
RESULTANT	246	50	283	69
IMPACT SEAT LOADS (LB)				
-X AXIS	-67	23	-73	24
+Z AXIS	2040	238	1960	256
RESULTANT	2040	238	1960	256

TABLE C-2 (CONTINUED)

MEANS AND STANDARD DEVIATIONS OF  
ELECTRONICALLY MEASURED AND COMPUTED DATA  
FROM VERTICAL TEST PHASE

(PEAK VALUES ARE TABULATED FOR VELOCITY, ACCELERATIONS AND LOADS.)

TEST CONDITION RESTRAINT HARNESS NEGATIVE G STRAP	G CONVENTIONAL NO (N = 15)		H CONVENTIONAL YES (N = 16)	
	MEAN	ST DEV	MEAN	ST DEV
CARRIAGE Z ACCELERATION (G)	9.97	0.05	10.0	0.05
CARRIAGE VELOCITY (FT/SEC)	-26.2	0.12	-26.2	0.25
SEAT Z ACCELERATION (G)	10.9	0.18	11.0	0.15
CHEST ACCELERATION (G)				
-X AXIS	-0.71	0.50	-0.74	0.60
+X AXIS	2.67	1.03	2.68	0.91
+Z AXIS	16.3	1.89	15.1	1.19
RESULTANT	16.5	1.85	15.3	1.20
CHEST SEVERITY INDEX	30.1	1.99	27.3	2.01
HEAD ACCELERATION (G)				
-X AXIS	-1.36	0.96	-1.78	1.04
+X AXIS	3.06	1.34	2.72	1.12
+Z AXIS	12.3	0.89	11.7	1.05
RESULTANT	12.8	0.88	12.1	0.90
HEAD SEVERITY INDEX	23.0	3.46	20.2	1.70
FREE FALL STRAP LOADS (LB)				
TOTAL SHOULDER STRAP	93	31	131	46
TOTAL LAP BELT	315	95	277	66
NEGATIVE G STRAP			223	67
IMPACT STRAP LOADS (LB)				
TOTAL SHOULDER STRAPS	74	37	40	45
TOTAL LAP BELTS	126	40	82	25
NEGATIVE G STRAP			101	26
FREE FALL SEAT LOADS (LB)				
+Z AXIS	270	82	410	104
RESULTANT	272	82	411	104
IMPACT SEAT LOADS (LB)				
-X AXIS	-60	24	-57	20
+Z AXIS	1890	222	1760	233
RESULTANT	1890	222	1760	234

HORIZONTAL TEST PHASE		TEST: 2092	SUBJ: B-2	WT: 188.0	CELL: A
PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			232		
TIME OF IMPACT START			289		
SLED ACCELERATION (G)					
X AXIS		0.61	460	-9.39	335
X AXIS (SMOOTHED)		0.48	461	-9.33	337
Y AXIS		0.49	343	-0.60	534
Z AXIS		2.01	459	0.18	339
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	263	-29.65	438
TACHOMETER (MEASURED)		0.21	261	-29.94	467
SEAT ACCELERATION (G)					
X AXIS		0.75	448	-10.03	341
X AXIS (SMOOTHED)		0.64	447	-9.80	340
Y AXIS		0.86	473	-0.64	468
Z AXIS		2.84	345	-0.91	340
CHEST ACCELERATION (G)					
X AXIS		7.54	485	-18.92	366
Y AXIS		0.52	367	-2.93	473
Z AXIS		17.83	369	-3.58	525
RESULTANT		25.84	367	0.53	537
CHEST SEVERITY INDEX		70.41			
HEAD ACCELERATION (G)					
X AXIS		2.17	512	-13.01	415
Y AXIS		1.12	563	-1.54	429
Z AXIS		3.05	503	-12.12	380
RESULTANT		15.82	379	0.53	812
HEAD SEVERITY INDEX		59.50			
SHOULDER STRAP LOADS (LB)					
X AXIS	60.17	712.61	373	6.96	497
Y AXIS	2.57	34.41	377	-12.27	582
Z AXIS	18.78	243.69	372	-4.48	481
RESULTANT	63.13	753.02	375	8.76	497
LEFT LAP LOADS (LB)					
X AXIS	25.51	675.17	358	14.06	821
Y AXIS	8.61	181.21	358	5.28	235
Z AXIS	36.82	694.33	360	28.85	475
RESULTANT	45.66	983.60	360	40.02	476
RIGHT LAP LOADS (LB)					
X AXIS	20.19	639.98	362	14.57	259
Y AXIS	5.51	189.71	364	0.69	288
Z AXIS	31.80	728.86	366	25.15	290
RESULTANT	38.14	986.82	364	34.02	243
TOTAL LAP LOAD (LB)	83.81	1967.23	363	74.57	477
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	41.95	61.08	368	-36.71	796
SEAT LOADS (LB)					
Z AXIS (LEFT)	12.61	484.28	371	-13.71	482
Z AXIS (RIGHT)	31.41	468.75	369	-4.70	519
Z AXIS (CENTER)	161.75	841.33	361	91.47	534
Z AXIS (SUM)	205.77	1774.46	368	95.94	532

HORIZONTAL TEST PHASE

TEST: 2132

SUBJ: B-1

WT: 150.0

CELL: A

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			170		
TIME OF IMPACT START			235		
SLED ACCELERATION (G)					
X AXIS		0.59	387	-9.70	287
X AXIS (SMOOTHED)		0.44	388	-9.61	286
Y AXIS		0.48	287	-0.27	480
Z AXIS		2.16	404	-0.14	283
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	200	-30.14	383
TACHOMETER (MEASURED)		0.21	174	-30.42	406
SEAT ACCELERATION (G)					
X AXIS		0.70	390	-10.23	285
X AXIS (SMOOTHED)		0.60	390	-10.00	285
Y AXIS		0.73	417	-0.62	341
Z AXIS		2.92	289	-1.15	283
CHEST ACCELERATION (G)					
X AXIS		7.39	422	-22.93	310
Y AXIS		2.53	299	-2.58	425
Z AXIS		17.93	306	-2.98	451
RESULTANT		28.51	309	0.84	472
CHEST SEVERITY INDEX		77.69			
HEAD ACCELERATION (G)					
X AXIS		1.27	491	-14.93	316
Y AXIS		1.25	313	-1.18	460
Z AXIS		4.65	406	-17.90	314
RESULTANT		23.05	315	0.26	206
HEAD SEVERITY INDEX		63.42			
SHOULDER STRAP LOADS (LB)					
X AXIS	22.65	560.60	335	-4.70	471
Y AXIS	1.16	29.49	299	-13.78	366
Z AXIS	10.27	211.33	313	-7.64	456
RESULTANT	24.99	595.02	335	2.23	450
LEFT LAP LOADS (LB)					
X AXIS	27.83	586.22	304	6.51	729
Y AXIS	11.87	189.96	306	5.82	737
Z AXIS	37.02	573.30	302	13.43	770
RESULTANT	47.86	841.41	304	21.47	770
RIGHT LAP LOADS (LB)					
X AXIS	23.96	578.14	304	10.50	409
Y AXIS	12.84	241.86	303	4.62	755
Z AXIS	31.60	602.03	303	19.37	732
RESULTANT	41.77	867.34	303	30.77	732
TOTAL LAP LOAD (LB)	89.63	1708.65	304	56.44	770
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-55.75	1.68	296	-99.85	417
SEAT LOADS (LB)					
Z AXIS (LEFT)	24.18	218.20	302	-14.80	726
Z AXIS (RIGHT)	6.28	318.89	314	-8.89	572
Z AXIS (CENTER)	121.77	821.56	303	87.19	436
Z AXIS (SUM)	152.24	1322.22	303	83.37	440

HORIZONTAL TEST PHASE

TEST: 2160

SUBJ: B-3

WT: 181.0

CELL: A

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			174		
TIME OF IMPACT START			244		
SLED ACCELERATION (G)					
X AXIS		0.65	398	-9.57	297
X AXIS (SMOOTHED)		0.51	400	-9.53	298
Y AXIS		0.49	298	-0.62	483
Z AXIS		2.31	416	0.00	293
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	234	-29.90	394
TACHOMETER (MEASURED)		0.17	197	-30.05	416
SEAT ACCELERATION (G)					
X AXIS		0.80	404	-10.28	294
X AXIS (SMOOTHED)		0.63	403	-9.98	295
Y AXIS		-0.04	430	-1.48	435
Z AXIS		3.57	542	-1.40	293
CHEST ACCELERATION (G)					
X AXIS		6.83	445	-16.42	314
Y AXIS		0.66	334	-3.00	318
Z AXIS		15.01	323	-3.56	468
RESULTANT		20.53	322	0.14	410
CHEST SEVERITY INDEX		53.22			
HEAD ACCELERATION (G)					
X AXIS		4.18	449	-11.81	371
Y AXIS		1.36	310	-1.60	364
Z AXIS		10.39	444	-6.33	479
RESULTANT		12.31	334	0.47	251
HEAD SEVERITY INDEX		42.99			
SHOULDER STRAP LOADS (LB)					
X AXIS	20.56	639.79	323	-4.59	438
Y AXIS	0.98	36.18	322	-5.94	417
Z AXIS	6.28	251.04	323	-9.29	737
RESULTANT	21.76	688.17	323	0.81	442
LEFT LAP LOADS (LB)					
X AXIS	53.38	742.42	315	22.10	687
Y AXIS	29.02	289.97	314	17.85	743
Z AXIS	79.90	765.77	314	46.50	756
RESULTANT	100.39	1104.99	315	61.12	768
RIGHT LAP LOADS (LB)					
X AXIS	48.58	684.84	314	29.29	758
Y AXIS	19.51	252.28	316	11.24	718
Z AXIS	75.05	770.88	315	61.02	766
RESULTANT	91.54	1058.87	314	71.14	764
TOTAL LAP LOAD (LB)	191.94	2163.14	315	135.47	764
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-37.59	0.73	313	-203.57	628
SEAT LOADS (LB)					
Z AXIS (LEFT)	42.49	406.88	315	-14.95	714
Z AXIS (RIGHT)	50.81	457.43	312	-9.96	421
Z AXIS (CENTER)	189.57	1066.71	314	174.33	191
Z AXIS (SUM)	282.86	1926.48	315	178.47	460



HORIZONTAL TEST PHASE      TEST: 2133      SUBJ: C-1      WT: 168.0      CELL: A

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			159		
TIME OF IMPACT START			221		
SLED ACCELERATION (G)					
X AXIS		0.64	374	-9.67	274
X AXIS (SMOOTHED)		0.53	375	-9.59	273
Y AXIS		0.48	284	-0.63	458
Z AXIS		2.36	392	0.10	270
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	203	-30.18	369
TACHOMETER (MEASURED)		0.22	193	-30.46	392
SEAT ACCELERATION (G)					
X AXIS		0.85	379	-10.29	271
X AXIS (SMOOTHED)		0.68	378	-10.05	271
Y AXIS		0.61	406	-0.65	327
Z AXIS		2.94	379	-1.11	270
CHEST ACCELERATION (G)					
X AXIS		8.10	418	-22.54	295
Y AXIS		1.33	285	-2.37	324
Z AXIS		14.08	297	-7.41	457
RESULTANT		26.38	296	0.54	687
CHEST SEVERITY INDEX		72.80			
HEAD ACCELERATION (G)					
X AXIS		1.70	502	-17.17	314
Y AXIS		1.24	316	-1.36	411
Z AXIS		7.42	414	-19.23	312
RESULTANT		25.47	313	0.34	618
HEAD SEVERITY INDEX		74.05			
SHOULDER STRAP LOADS (LB)					
X AXIS	19.33	673.67	298	1.62	413
Y AXIS	1.48	20.38	291	-9.22	332
Z AXIS	7.44	251.92	300	-3.55	160
RESULTANT	20.86	717.80	298	3.10	413
LEFT LAP LOADS (LB)					
X AXIS	31.58	729.89	293	12.04	651
Y AXIS	16.09	259.96	293	7.79	639
Z AXIS	42.96	711.78	294	22.39	747
RESULTANT	55.74	1052.11	294	32.17	747
RIGHT LAP LOADS (LB)					
X AXIS	28.98	702.62	293	11.90	410
Y AXIS	10.68	234.07	294	5.71	207
Z AXIS	43.82	766.40	294	21.67	407
RESULTANT	53.70	1065.76	294	32.11	406
TOTAL LAP LOAD (LB)	109.44	2117.87	294	77.26	407
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-78.70	-8.78	291	-81.66	182
SEAT LOADS (LB)					
Z AXIS (LEFT)	34.84	439.08	297	-7.13	396
Z AXIS (RIGHT)	37.45	429.33	296	4.43	437
Z AXIS (CENTER)	117.93	949.14	292	50.76	461
Z AXIS (SUM)	190.23	1799.26	296	67.83	461

HORIZONTAL TEST PHASE

TEST: 2142

SUBJ: C-2

WT: 189.0

CELL: A

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			230		
TIME OF IMPACT START			295		
SLED ACCELERATION (G)					
X AXIS		0.58	448	-9.69	342
X AXIS (SMOOTHED)		0.48	466	-9.80	344
Y AXIS		0.47	371	-0.45	555
Z AXIS		2.11	465	0.15	359
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	269	-90.02	444
TACHOMETER (MEASURED)		0.23	273	-30.33	522
SEAT ACCELERATION (G)					
X AXIS		0.73	453	-10.36	348
X AXIS (SMOOTHED)		0.62	452	-10.08	347
Y AXIS		0.69	478	-0.79	473
Z AXIS		2.62	352	-0.92	346
CHEST ACCELERATION (G)					
X AXIS		6.32	505	-24.14	369
Y AXIS		1.03	370	-2.84	504
Z AXIS		17.99	372	-4.27	533
RESULTANT		29.39	371	0.51	639
CHEST SEVERITY INDEX		84.25			
HEAD ACCELERATION (G)					
X AXIS		4.23	596	-19.29	385
Y AXIS		1.78	644	-1.34	595
Z AXIS		6.71	448	-14.02	379
RESULTANT		23.31	381	0.20	509
HEAD SEVERITY INDEX		100.71			
SHOULDER STRAP LOADS (LB)					
X AXIS	28.15	777.12	378	-7.59	492
Y AXIS	0.71	26.30	404	-5.58	507
Z AXIS	12.89	302.91	376	-13.38	509
RESULTANT	31.11	832.41	378	1.26	498
LEFT LAP LOADS (LB)					
X AXIS	17.27	801.72	370	7.40	272
Y AXIS	7.41	260.57	372	2.53	784
Z AXIS	24.35	833.76	370	12.87	799
RESULTANT	30.86	1185.41	370	21.34	799
RIGHT LAP LOADS (LB)					
X AXIS	16.33	778.37	370	2.26	252
Y AXIS	9.96	232.52	371	-2.18	286
Z AXIS	23.39	854.95	370	13.79	243
RESULTANT	28.93	1178.61	370	20.66	490
TOTAL LAP LOAD (LB)	59.79	2364.02	370	52.39	263
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	101.68	133.07	367	39.64	534
SEAT LOADS (LB)					
Z AXIS (LEFT)	11.54	438.99	373	-14.83	523
Z AXIS (RIGHT)	37.60	461.05	369	-0.27	630
Z AXIS (CENTER)	137.33	1008.28	368	60.11	547
Z AXIS (SUM)	186.48	1894.57	371	73.89	547

HORIZONTAL TEST PHASE

TEST: 2107

SUBJ: F-2

WT: 152.0

CELL: A

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			168		
TIME OF IMPACT START			227		
SLED ACCELERATION (G)					
X AXIS		0.48	379	-9.52	280
X AXIS (SMOOTHED)		0.31	360	-9.48	280
Y AXIS		0.47	281	-0.30	179
Z AXIS		1.46	283	0.16	276
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	180	-30.04	376
TACHOMETER (MEASURED)		0.21	161	-30.35	404
SEAT ACCELERATION (G)					
X AXIS		0.58	383	-10.19	278
X AXIS (SMOOTHED)		0.47	383	-9.94	277
Y AXIS		0.64	389	-0.73	346
Z AXIS		2.49	282	-0.59	277
CHEST ACCELERATION (G)					
X AXIS		6.27	417	-19.32	298
Y AXIS		1.55	358	-2.62	296
Z AXIS		10.58	295	-3.49	427
RESULTANT		21.84	296	0.37	574
CHEST SEVERITY INDEX		52.70			
HEAD ACCELERATION (G)					
X AXIS		1.53	487	-12.48	336
Y AXIS		2.10	441	0.09	333
Z AXIS		6.81	418	-7.42	335
RESULTANT		14.50	336	0.73	593
HEAD SEVERITY INDEX		46.65			
SHOULDER STRAP LOADS (LB)					
X AXIS	55.23	535.22	311	9.45	515
Y AXIS	2.19	22.86	289	-3.32	421
Z AXIS	21.85	225.25	309	-1.02	506
RESULTANT	59.48	579.89	311	12.91	515
LEFT LAP LOADS (LB)					
X AXIS	38.93	654.94	300	13.57	720
Y AXIS	21.58	270.99	297	9.43	760
Z AXIS	54.27	661.49	298	29.89	730
RESULTANT	70.23	967.85	298	42.00	755
RIGHT LAP LOADS (LB)					
X AXIS	39.89	617.67	299	14.87	732
Y AXIS	11.93	218.16	301	5.02	753
Z AXIS	57.53	697.22	297	38.65	723
RESULTANT	71.04	955.82	299	48.56	732
TOTAL LAP LOAD (LB)	141.26	1923.34	299	94.05	732
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	60.52	75.87	297	-1.37	704
SEAT LOADS (LB)					
Z AXIS (LEFT)	12.24	278.14	310	-14.25	647
Z AXIS (RIGHT)	59.97	400.01	299	6.98	687
Z AXIS (CENTER)	123.26	838.66	298	101.20	242
Z AXIS (SUM)	195.48	1483.20	299	179.12	167

HORIZONTAL TEST PHASE		TEST: 2122	SUBJ: G-3	WT: 163.0	CELL: A
PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			203		
TIME OF IMPACT START			265		
SLED ACCELERATION (G)					
X AXIS		0.63	419	-9.56	312
X AXIS (SMOOTHED)		0.43	420	-9.43	314
Y AXIS		0.47	321	-0.41	510
Z AXIS		1.93	435	0.16	331
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.02	255	-29.63	415
TACHOMETER (MEASURED)		0.10	243	-29.99	444
SEAT ACCELERATION (G)					
X AXIS		0.75	420	-10.09	319
X AXIS (SMOOTHED)		0.63	422	-9.86	318
Y AXIS		0.74	430	-0.57	365
Z AXIS		2.70	323	-0.96	318
CHEST ACCELERATION (G)					
X AXIS		6.73	453	-20.08	344
Y AXIS		1.07	469	-4.04	438
Z AXIS		12.86	343	-5.83	491
RESULTANT		23.87	344	0.19	476
CHEST SEVERITY INDEX		56.84			
HEAD ACCELERATION (G)					
X AXIS		2.00	488	-13.14	388
Y AXIS		2.05	358	-0.90	472
Z AXIS		4.28	454	-11.88	353
RESULTANT		17.12	386	0.33	691
HEAD SEVERITY INDEX		65.46			
SHOULDER STRAP LOADS (LB)					
X AXIS	32.77	643.07	347	0.67	470
Y AXIS	6.13	33.83	342	-16.46	378
Z AXIS	14.69	277.95	349	-4.28	468
RESULTANT	36.59	700.31	347	3.96	469
LEFT LAP LOADS (LB)					
X AXIS	23.83	718.98	340	15.94	242
Y AXIS	9.92	264.40	341	7.53	260
Z AXIS	34.15	703.29	340	27.85	223
RESULTANT	42.89	1039.04	340	37.98	223
RIGHT LAP LOADS (LB)					
X AXIS	21.25	696.79	338	8.59	257
Y AXIS	10.94	283.39	340	4.29	204
Z AXIS	31.99	723.85	339	22.20	238
RESULTANT	39.63	1043.25	339	34.56	238
TOTAL LAP LOAD (LB)	82.52	2081.55	340	75.55	238
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	77.43	122.27	398	-54.00	645
SEAT LOADS (LB)					
Z AXIS (LEFT)	18.74	322.49	343	-14.07	605
Z AXIS (RIGHT)	26.56	389.42	345	-5.13	466
Z AXIS (CENTER)	134.67	879.56	340	83.23	482
Z AXIS (SUM)	180.96	1588.66	340	89.84	482

HORIZONTAL TEST PHASE      TEST: 2135      SUBJ: H-6      WT: 187.0      CELL: A

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			223		
TIME OF IMPACT START			288		
SLED ACCELERATION (G)					
X AXIS		0.61	441	-9.68	335
X AXIS (SMOOTHED)		0.48	459	-9.64	337
Y AXIS		0.48	343	-0.46	543
Z AXIS		1.98	457	0.17	353
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	274	-30.08	437
TACHOMETER (MEASURED)		0.16	270	-30.35	458
SEAT ACCELERATION (G)					
X AXIS		0.73	442	-10.30	341
X AXIS (SMOOTHED)		0.64	444	-10.08	340
Y AXIS		0.46	471	-0.62	387
Z AXIS		2.67	345	-0.83	340
CHEST ACCELERATION (G)					
X AXIS		7.29	494	-31.21	363
Y AXIS		1.52	485	-3.09	355
Z AXIS		21.51	369	-2.71	543
RESULTANT		32.07	363	0.42	565
CHEST SEVERITY INDEX		107.51			
HEAD ACCELERATION (G)					
X AXIS		1.81	513	-17.38	402
Y AXIS		1.46	374	-1.76	574
Z AXIS		6.63	491	-9.88	376
RESULTANT		18.68	377	0.28	663
HEAD SEVERITY INDEX		79.13			
SHOULDER STRAP LOADS (LB)					
X AXIS	32.22	906.98	371	-4.23	482
Y AXIS	1.50	53.97	371	-10.93	449
Z AXIS	13.92	341.79	373	-6.13	516
RESULTANT	35.17	969.05	371	1.28	495
LEFT LAP LOADS (LB)					
X AXIS	20.08	770.00	364	10.21	276
Y AXIS	6.61	262.50	365	0.94	271
Z AXIS	25.18	779.36	364	16.26	266
RESULTANT	33.03	1126.59	364	26.72	266
RIGHT LAP LOADS (LB)					
X AXIS	15.87	720.05	365	6.73	261
Y AXIS	5.13	246.88	365	-0.51	256
Z AXIS	22.65	811.46	365	15.43	251
RESULTANT	28.27	1112.60	365	23.25	820
TOTAL LAP LOAD (LB)	61.29	2239.19	365	54.67	266
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	24.83	88.34	707	9.85	546
SEAT LOADS (LB)					
Z AXIS (LEFT)	31.31	387.97	361	-4.93	468
Z AXIS (RIGHT)	34.69	393.12	369	-10.53	715
Z AXIS (CENTER)	123.08	1008.03	366	47.47	550
Z AXIS (SUM)	189.08	1784.56	367	60.87	550

HORIZONTAL TEST PHASE

TEST: 2147

SUBJ: J-3

WT: 166.0

CELL: A

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			170		
TIME OF IMPACT START			243		
SLED ACCELERATION (G)					
X AXIS		0.58	395	-9.66	307
X AXIS (SMOOTHED)		0.45	397	-9.57	297
Y AXIS		0.44	289	-0.44	484
Z AXIS		2.02	413	0.03	291
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	223	-30.16	391
TACHOMETER (MEASURED)		0.28	240	-30.46	415
SEAT ACCELERATION (G)					
X AXIS		0.64	398	-10.35	292
X AXIS (SMOOTHED)		0.53	398	-10.02	293
Y AXIS		0.44	491	-0.66	420
Z AXIS		3.05	296	-1.29	291
CHEST ACCELERATION (G)					
X AXIS		8.95	434	-11.89	320
Y AXIS		0.98	402	-3.83	428
Z AXIS		13.91	319	-6.27	427
RESULTANT		18.63	319	0.49	553
CHEST SEVERITY INDEX		44.88			
HEAD ACCELERATION (G)					
X AXIS		2.05	510	-12.81	373
Y AXIS		1.75	466	-2.00	413
Z AXIS		8.87	430	-14.98	338
RESULTANT		18.18	339	0.30	536
HEAD SEVERITY INDEX		68.28			
SHOULDER STRAP LOADS (LB)					
X AXIS	46.92	504.63	329	4.55	432
Y AXIS	0.09	35.52	331	-7.74	530
Z AXIS	15.91	185.84	326	0.92	429
RESULTANT	49.59	537.20	329	7.34	430
LEFT LAP LOADS (LB)					
X AXIS	65.32	571.61	306	36.31	761
Y AXIS	33.83	224.12	306	15.34	770
Z AXIS	89.18	586.65	307	46.70	770
RESULTANT	115.65	849.20	307	62.61	770
RIGHT LAP LOADS (LB)					
X AXIS	59.78	537.10	307	37.27	419
Y AXIS	20.55	163.00	307	12.03	644
Z AXIS	86.05	595.67	306	54.04	653
RESULTANT	106.80	816.96	307	70.43	729
TOTAL LAP LOAD (LB)	222.45	1666.16	307	134.63	770
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	2.43	113.55	510	0.19	229
SEAT LOADS (LB)					
Z AXIS (LEFT)	73.19	388.98	309	6.73	430
Z AXIS (RIGHT)	100.43	496.43	309	-13.44	481
Z AXIS (CENTER)	98.97	704.55	312	87.91	205
Z AXIS (SUM)	272.59	1579.27	311	136.32	458

AD-A138 642

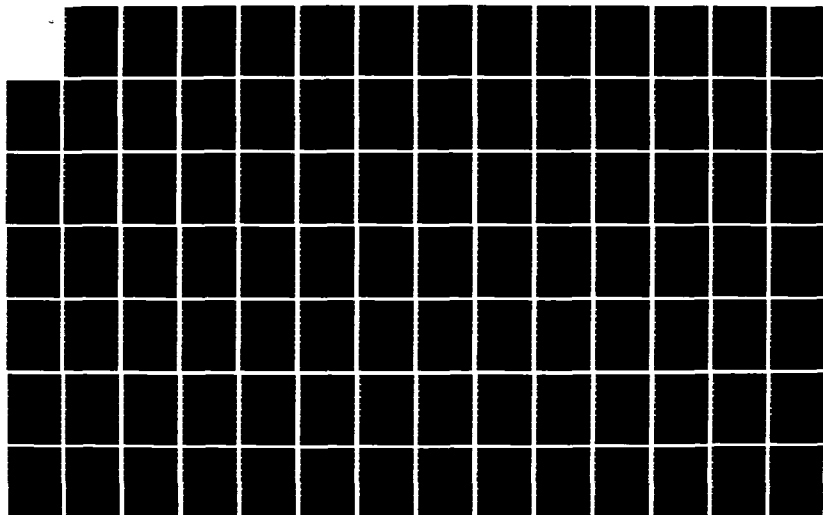
EFFECTS OF A NEGATIVE G STRAP ON RESTRAINT DYNAMICS AND  
HUMAN IMPACT RESPONSE(U) AIR FORCE AEROSPACE MEDICAL  
RESEARCH LAB WRIGHT-PATTERSON AFB. B F HEARON ET AL.  
DEC 83 AFAMRL-TR-83-083

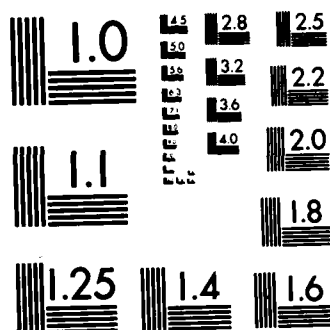
2/4

UNCLASSIFIED

F/G 6/17

NL





MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS-1963-A



HORIZONTAL TEST PHASE      TEST: 2121      SUBJ: J-4      WT: 181.0      CELL: A

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			211		
TIME OF IMPACT START			272		
SLED ACCELERATION (G)					
X AXIS		0.66	426	-9.41	325
X AXIS (SMOOTHED)		0.45	427	-9.34	325
Y AXIS		0.50	325	-0.42	529
Z AXIS		1.75	441	0.07	321
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	233	-29.73	422
TACHOMETER (MEASURED)		0.16	214	-29.94	444
SEAT ACCELERATION (G)					
X AXIS		0.72	426	-10.03	322
X AXIS (SMOOTHED)		0.62	429	-9.80	322
Y AXIS		0.63	436	-0.79	450
Z AXIS		3.00	327	-1.19	321
CHEST ACCELERATION (G)					
X AXIS		7.44	466	-16.67	345
Y AXIS		0.48	402	-2.43	444
Z AXIS		12.11	342	-2.76	515
RESULTANT		20.42	344	0.57	536
CHEST SEVERITY INDEX		48.50			
HEAD ACCELERATION (G)					
X AXIS		0.67	221	-10.18	388
Y AXIS		0.69	510	-0.91	408
Z AXIS		6.16	461	-2.75	380
RESULTANT		10.62	389	0.59	474
HEAD SEVERITY INDEX		54.24			
SHOULDER STRAP LOADS (LB)					
X AXIS	64.83	548.55	354	10.91	463
Y AXIS	1.02	18.83	340	-11.91	378
Z AXIS	12.46	157.17	350	-3.41	507
RESULTANT	66.09	570.72	354	13.21	463
LEFT LAP LOADS (LB)					
X AXIS	54.07	788.60	344	21.41	804
Y AXIS	21.42	241.22	343	6.64	467
Z AXIS	82.57	817.14	344	30.13	809
RESULTANT	101.03	1160.94	344	39.76	809
RIGHT LAP LOADS (LB)					
X AXIS	50.03	740.75	346	14.87	795
Y AXIS	18.32	235.62	345	0.91	790
Z AXIS	76.77	795.91	344	20.39	808
RESULTANT	93.49	1110.78	346	27.76	808
TOTAL LAP LOAD (LB)	194.52	2271.52	344	69.05	808
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-34.46	123.28	728	-114.04	483
SEAT LOADS (LB)					
Z AXIS (LEFT)	69.14	518.27	349	-14.74	508
Z AXIS (RIGHT)	60.82	389.57	348	-11.05	660
Z AXIS (CENTER)	172.96	1183.22	349	129.71	497
Z AXIS (SUM)	302.92	2091.06	349	129.74	497

HORIZONTAL TEST PHASE      TEST: 2106      SUBJ: K-1      WT: 179.0      CELL: A

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			211		
TIME OF IMPACT START			269		
SLED ACCELERATION (G)					
X AXIS		0.64	423	-9.56	320
X AXIS (SMOOTHED)		0.47	442	-9.48	322
Y AXIS		0.45	321	-0.62	510
Z AXIS		2.19	441	-0.35	317
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	238	-29.89	418
TACHOMETER (MEASURED)		0.22	210	-30.11	443
SEAT ACCELERATION (G)					
X AXIS		0.80	429	-10.17	318
X AXIS (SMOOTHED)		0.62	428	-9.85	319
Y AXIS		0.82	455	-0.62	317
Z AXIS		3.66	323	-1.72	318
CHEST ACCELERATION (G)					
X AXIS		6.34	466	-18.93	347
Y AXIS		0.50	469	-3.91	446
Z AXIS		15.79	351	-4.81	505
RESULTANT		23.86	349	0.78	712
CHEST SEVERITY INDEX		58.69			
HEAD ACCELERATION (G)					
X AXIS		2.30	491	-10.69	351
Y AXIS		1.05	488	-1.44	391
Z AXIS		4.31	474	-10.27	370
RESULTANT		13.24	370	0.65	605
HEAD SEVERITY INDEX		38.03			
SHOULDER STRAP LOADS (LB)					
X AXIS	38.11	732.77	352	3.40	471
Y AXIS	2.89	33.68	343	-8.45	555
Z AXIS	15.52	290.75	350	-1.22	481
RESULTANT	41.31	788.76	352	3.96	481
LEFT LAP LOADS (LB)					
X AXIS	32.07	720.91	344	10.46	686
Y AXIS	10.96	226.16	344	3.31	744
Z AXIS	45.31	733.18	345	21.88	677
RESULTANT	56.64	1051.42	344	30.29	686
RIGHT LAP LOADS (LB)					
X AXIS	37.73	698.20	344	17.53	810
Y AXIS	13.57	231.68	343	5.86	762
Z AXIS	52.03	746.13	344	28.07	795
RESULTANT	65.74	1047.79	344	39.19	795
TOTAL LAP LOAD (LB)	122.38	2099.22	344	78.06	777
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	72.64	83.90	351	24.11	491
SEAT LOADS (LB)					
Z AXIS (LEFT)	45.75	454.18	344	-1.16	501
Z AXIS (RIGHT)	59.27	494.73	347	-3.00	666
Z AXIS (CENTER)	85.89	813.07	348	63.21	284
Z AXIS (SUM)	190.91	1761.99	348	111.35	511

HORIZONTAL TEST PHASE

TEST: 2127

SUBJ: M13

WT: 175.0

CELL: A

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			170		
TIME OF IMPACT START			233		
SLED ACCELERATION (G)					
X AXIS		0.59	387	-9.48	286
X AXIS (SMOOTHED)		0.43	388	-9.40	287
Y AXIS		0.49	285	-0.31	504
Z AXIS		2.16	405	0.03	281
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	222	-29.78	383
TACHOMETER (MEASURED)		0.16	183	-30.11	410
SEAT ACCELERATION (G)					
X AXIS		0.68	389	-10.10	282
X AXIS (SMOOTHED)		0.54	390	-9.86	283
Y AXIS		0.54	400	-0.54	339
Z AXIS		3.08	287	-1.18	282
CHEST ACCELERATION (G)					
X AXIS		6.31	416	-17.52	316
Y AXIS		0.46	402	-2.54	317
Z AXIS		9.12	300	-1.56	436
RESULTANT		17.77	317	0.48	514
CHEST SEVERITY INDEX		46.26			
HEAD ACCELERATION (G)					
X AXIS		1.46	457	-10.89	340
Y AXIS		1.53	510	-5.85	368
Z AXIS		2.59	414	-14.44	334
RESULTANT		17.81	334	0.10	446
HEAD SEVERITY INDEX		67.63			
SHOULDER STRAP LOADS (LB)					
X AXIS	46.02	630.85	333	0.32	470
Y AXIS	4.53	38.23	310	-6.17	451
Z AXIS	15.77	251.19	333	-6.72	531
RESULTANT	48.88	679.60	333	5.25	463
LEFT LAP LOADS (LB)					
X AXIS	50.32	631.02	297	38.98	189
Y AXIS	15.04	182.67	298	10.25	226
Z AXIS	65.23	634.35	297	46.58	766
RESULTANT	83.81	912.74	297	64.12	765
RIGHT LAP LOADS (LB)					
X AXIS	40.99	594.06	297	21.40	761
Y AXIS	14.69	197.38	298	7.08	749
Z AXIS	51.78	620.90	299	38.24	744
RESULTANT	67.71	880.25	298	50.13	769
TOTAL LAP LOAD (LB)	151.52	1792.71	297	118.48	766
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	7.30	41.11	288	4.36	179
SEAT LOADS (LB)					
Z AXIS (LEFT)	51.59	344.90	299	-8.41	624
Z AXIS (RIGHT)	40.24	337.13	302	-11.90	527
Z AXIS (CENTER)	114.59	726.99	301	104.17	239
Z AXIS (SUM)	206.42	1407.50	301	202.58	209

HORIZONTAL TEST PHASE      TEST: 2054      SUBJ: P-3      WT: 196.0      CELL: A

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			175		
TIME OF IMPACT START			236		
SLED ACCELERATION (G)					
X AXIS		0.74	391	-9.67	285
X AXIS (SMOOTHED)		0.58	392	-9.59	286
Y AXIS		0.50	296	-0.57	499
Z AXIS		1.23	278	0.53	270
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	217	-29.71	386
TACHOMETER (MEASURED)		0.19	242	-29.91	406
SEAT ACCELERATION (G)					
X AXIS		0.63	390	-9.70	281
X AXIS (SMOOTHED)		0.51	634	-9.59	283
Y AXIS		0.42	639	-0.66	335
Z AXIS		2.36	277	-0.27	271
CHEST ACCELERATION (G)					
X AXIS		5.12	417	-20.69	312
Y AXIS		3.62	310	-2.16	535
Z AXIS		23.43	319	-2.06	462
RESULTANT		27.97	319	0.64	597
CHEST SEVERITY INDEX		72.12			
HEAD ACCELERATION (G)					
X AXIS		0.36	271	-11.34	433
Y AXIS		3.55	324	-0.87	477
Z AXIS		3.34	400	-12.38	333
RESULTANT		14.43	390	0.15	290
HEAD SEVERITY INDEX		70.27			
SHOULDER STRAP LOADS (LB)					
X AXIS	61.95	773.13	323	-1.70	466
Y AXIS	-0.77	50.28	338	-8.93	617
Z AXIS	11.53	185.06	323	-9.59	456
RESULTANT	63.05	795.02	323	2.76	476
LEFT LAP LOADS (LB)					
X AXIS	35.47	729.24	306	26.20	220
Y AXIS	9.52	218.35	308	4.88	236
Z AXIS	44.35	701.22	306	39.73	203
RESULTANT	57.70	1033.76	306	53.54	220
RIGHT LAP LOADS (LB)					
X AXIS	36.97	702.77	307	27.13	758
Y AXIS	11.60	182.20	307	8.40	753
Z AXIS	46.49	711.13	309	44.36	173
RESULTANT	60.55	1014.83	307	57.51	212
TOTAL LAP LOAD (LB)	118.26	2047.72	307	113.71	192
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	60.47	90.22	319	41.01	761
SEAT LOADS (LB)					
Z AXIS (LEFT)	38.56	470.51	305	-15.29	457
Z AXIS (RIGHT)	54.36	447.57	309	-7.68	608
Z AXIS (CENTER)	138.57	858.18	315	120.72	172
Z AXIS (SUM)	231.48	1756.25	311	197.88	447

HORIZONTAL TEST PHASE

TEST: 2154

SUBJ: R-2

WT: 144.0

CELL: A

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			190		
TIME OF IMPACT START			258		
SLED ACCELERATION (G)					
X AXIS		0.55	411	-9.65	306
X AXIS (SMOOTHED)		0.35	412	-9.55	307
Y AXIS		0.50	314	-0.33	509
Z AXIS		1.42	315	0.08	310
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.02	245	-29.98	407
TACHOMETER (MEASURED)		0.21	244	-30.30	431
SEAT ACCELERATION (G)					
X AXIS		0.68	416	-10.30	312
X AXIS (SMOOTHED)		0.56	414	-10.02	310
Y AXIS		0.69	419	-0.64	415
Z AXIS		2.60	315	-1.13	310
CHEST ACCELERATION (G)					
X AXIS		7.43	440	-18.56	335
Y AXIS		4.64	420	-3.40	463
Z AXIS		16.97	325	-2.75	491
RESULTANT		19.45	326	0.60	535
CHEST SEVERITY INDEX		63.87			
HEAD ACCELERATION (G)					
X AXIS		2.50	532	-15.48	349
Y AXIS		1.15	521	-1.21	536
Z AXIS		4.56	452	-13.34	339
RESULTANT		19.48	340	0.77	675
HEAD SEVERITY INDEX		78.62			
SHOULDER STRAP LOADS (LB)					
X AXIS	29.89	719.64	353	-3.80	476
Y AXIS	2.30	27.58	347	-11.13	351
Z AXIS	14.99	280.48	348	-9.05	504
RESULTANT	33.54	772.71	354	2.25	492
LEFT LAP LOADS (LB)					
X AXIS	13.91	544.38	322	4.14	256
Y AXIS	10.39	226.21	324	5.70	233
Z AXIS	18.53	572.95	323	11.08	211
RESULTANT	26.25	821.74	323	21.28	211
RIGHT LAP LOADS (LB)					
X AXIS	14.17	501.13	323	11.35	195
Y AXIS	7.69	220.72	323	5.05	244
Z AXIS	17.52	550.70	325	9.07	246
RESULTANT	23.94	775.15	323	18.22	246
TOTAL LAP LOAD (LB)	50.19	1596.89	323	44.54	246
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	52.20	130.46	653	11.49	580
SEAT LOADS (LB)					
Z AXIS (LEFT)	10.57	269.70	327	-15.08	432
Z AXIS (RIGHT)	16.81	270.54	327	-13.23	688
Z AXIS (CENTER)	108.75	818.46	330	93.38	220
Z AXIS (SUM)	136.14	1346.30	328	98.55	482

HORIZONTAL TEST PHASE

TEST: 2128

SUBJ: R-3

WT: 150.0

CELL: A

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			165		
TIME OF IMPACT START			228		
SLED ACCELERATION (G)					
X AXIS		0.60	399	-9.56	277
X AXIS (SMOOTHED)		0.49	400	-9.49	277
Y AXIS		0.47	282	-0.48	477
Z AXIS		2.21	398	0.25	279
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	214	-29.87	377
TACHOMETER (MEASURED)		0.22	196	-30.11	401
SEAT ACCELERATION (G)					
X AXIS		0.69	385	-10.22	280
X AXIS (SMOOTHED)		0.60	385	-10.00	279
Y AXIS		-0.13	412	-1.48	347
Z AXIS		2.59	284	-0.96	279
CHEST ACCELERATION (G)					
X AXIS		7.55	425	-21.26	297
Y AXIS		2.50	433	-2.10	407
Z AXIS		10.67	309	-12.78	461
RESULTANT		23.12	297	0.33	527
CHEST SEVERITY INDEX		64.13			
HEAD ACCELERATION (G)					
X AXIS		2.26	449	-12.48	349
Y AXIS		0.70	521	-1.98	331
Z AXIS		6.34	430	-11.20	316
RESULTANT		15.87	316	0.57	733
HEAD SEVERITY INDEX		51.30			
SHOULDER STRAP LOADS (LB)					
X AXIS	36.33	684.02	308	-5.81	489
Y AXIS	2.57	42.65	295	-6.31	385
Z AXIS	19.76	325.44	311	-5.45	472
RESULTANT	41.49	757.25	308	0.86	442
LEFT LAP LOADS (LB)					
X AXIS	20.03	698.51	302	2.86	759
Y AXIS	2.39	246.40	303	-2.25	190
Z AXIS	25.98	687.23	302	13.79	749
RESULTANT	32.96	1009.84	302	20.66	749
RIGHT LAP LOADS (LB)					
X AXIS	16.68	678.05	302	2.41	737
Y AXIS	8.42	275.75	302	1.72	732
Z AXIS	25.44	715.20	302	13.54	727
RESULTANT	31.80	1023.38	302	21.74	727
TOTAL LAP LOAD (LB)	64.76	2033.21	302	50.29	749
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	4.78	46.72	299	-68.52	732
SEAT LOADS (LB)					
Z AXIS (LEFT)	7.22	234.80	304	-13.43	607
Z AXIS (RIGHT)	10.93	301.86	307	-12.26	602
Z AXIS (CENTER)	136.34	929.20	301	49.21	456
Z AXIS (SUM)	154.48	1459.78	302	53.90	456

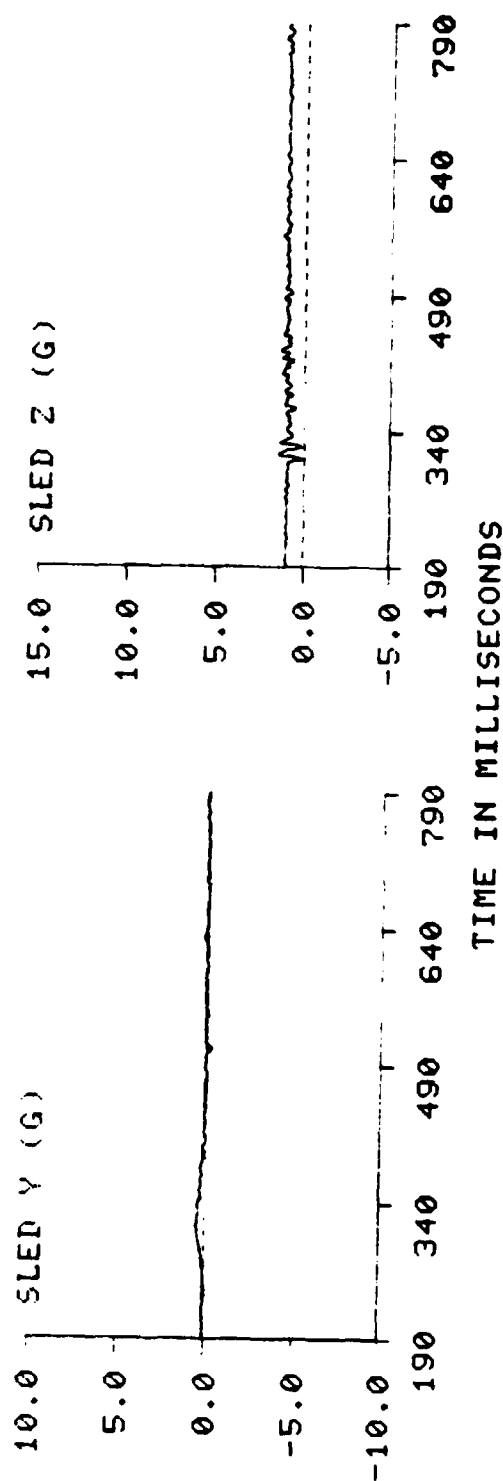
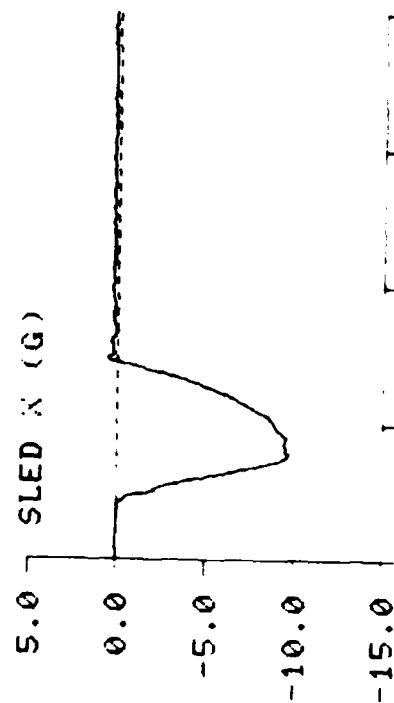
HORIZONTAL TEST PHASE      TEST: 2101      SUBJ: W-4      WT: 192.0      CELL: A

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			199		
TIME OF IMPACT START			258		
SLED ACCELERATION (G)					
X AXIS		0.63	412	-9.51	303
X AXIS (SMOOTHED)		0.50	432	-9.44	306
Y AXIS		0.49	314	-0.60	502
Z AXIS		2.12	430	0.11	423
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	190	-29.80	407
TACHOMETER (MEASURED)		0.15	200	-30.06	435
SEAT ACCELERATION (G)					
X AXIS		0.87	418	-10.06	311
X AXIS (SMOOTHED)		0.63	418	-9.85	310
Y AXIS		0.77	445	-0.65	451
Z AXIS		3.14	418	-0.91	310
CHEST ACCELERATION (G)					
X AXIS		6.93	456	-32.43	333
Y AXIS		1.25	475	-3.91	330
Z AXIS		15.15	337	-3.85	496
RESULTANT		34.74	334	0.39	508
CHEST SEVERITY INDEX		90.81			
HEAD ACCELERATION (G)					
X AXIS		1.64	566	-14.67	352
Y AXIS		0.30	361	-2.43	407
Z AXIS		5.56	469	-14.34	349
RESULTANT		19.83	350	0.30	597
HEAD SEVERITY INDEX		59.18			
SHOULDER STRAP LOADS (LB)					
X AXIS	36.65	683.23	336	-2.65	572
Y AXIS	3.37	30.60	336	-13.80	525
Z AXIS	15.18	271.23	337	-6.13	746
RESULTANT	39.88	734.85	336	1.76	478
LEFT LAP LOADS (LB)					
X AXIS	21.76	847.26	335	15.94	199
Y AXIS	8.82	309.55	336	6.94	194
Z AXIS	34.23	934.89	335	26.34	446
RESULTANT	41.59	1298.56	335	33.14	446
RIGHT LAP LOADS (LB)					
X AXIS	19.04	785.20	336	11.60	453
Y AXIS	7.92	332.64	335	4.06	448
Z AXIS	27.62	938.13	335	23.10	450
RESULTANT	34.50	1266.23	335	30.25	446
TOTAL LAP LOAD (LB)	76.09	2564.78	335	63.40	446
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	45.45	129.31	338	25.91	507
SEAT LOADS (LB)					
Z AXIS (LEFT)	33.29	412.85	335	4.72	435
Z AXIS (RIGHT)	34.54	456.58	338	-12.32	572
Z AXIS (CENTER)	145.32	1312.99	338	113.84	504
Z AXIS (SUM)	213.15	2177.86	338	135.10	504

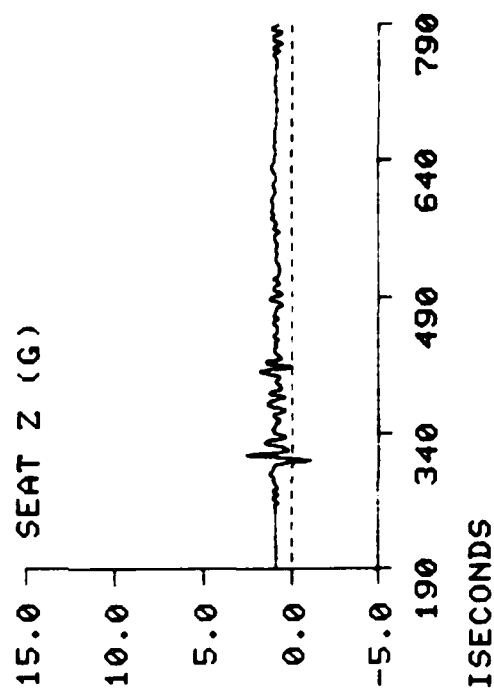
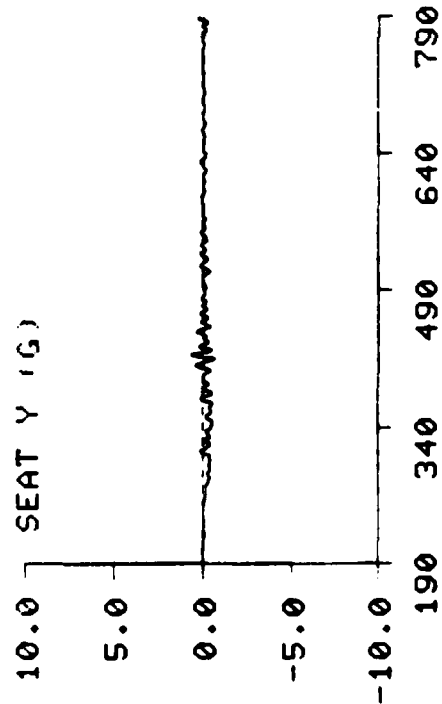
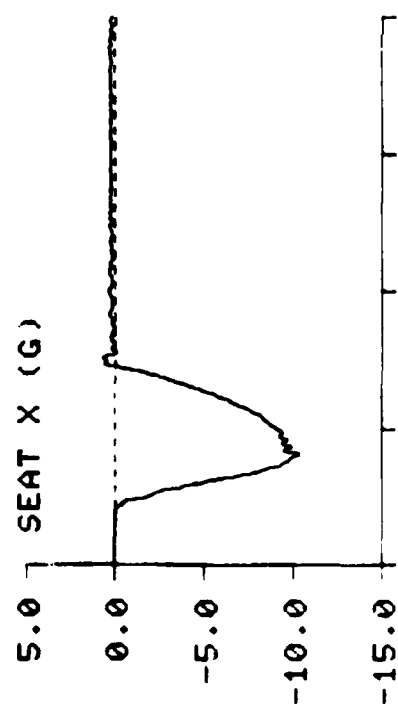
RESTRAINT CONFIGURATION STUDY

TEST NO: 2154

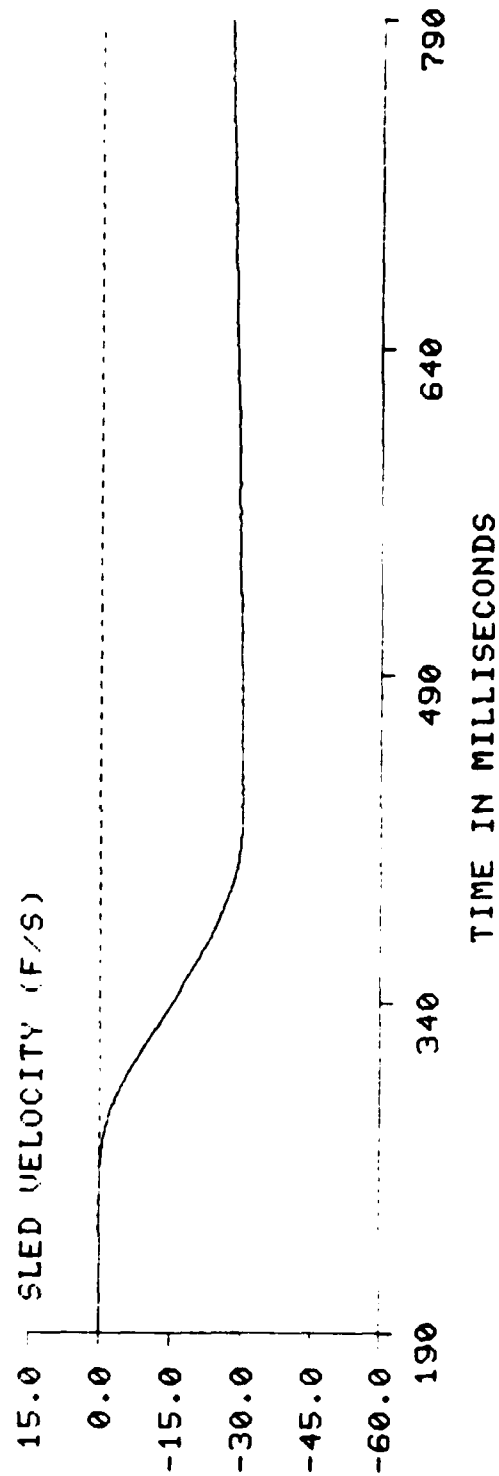
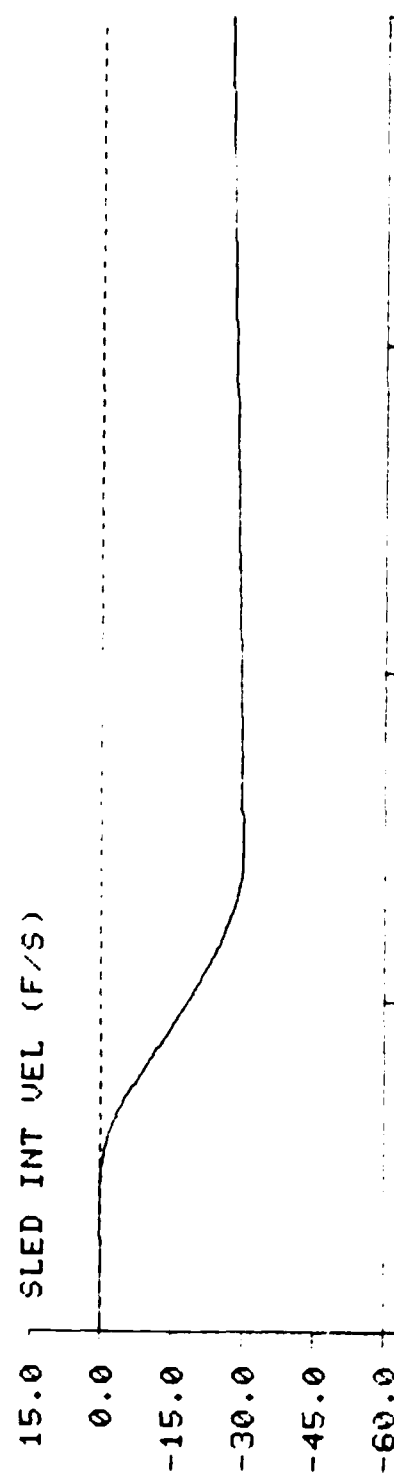
SUBJ ID: R-2







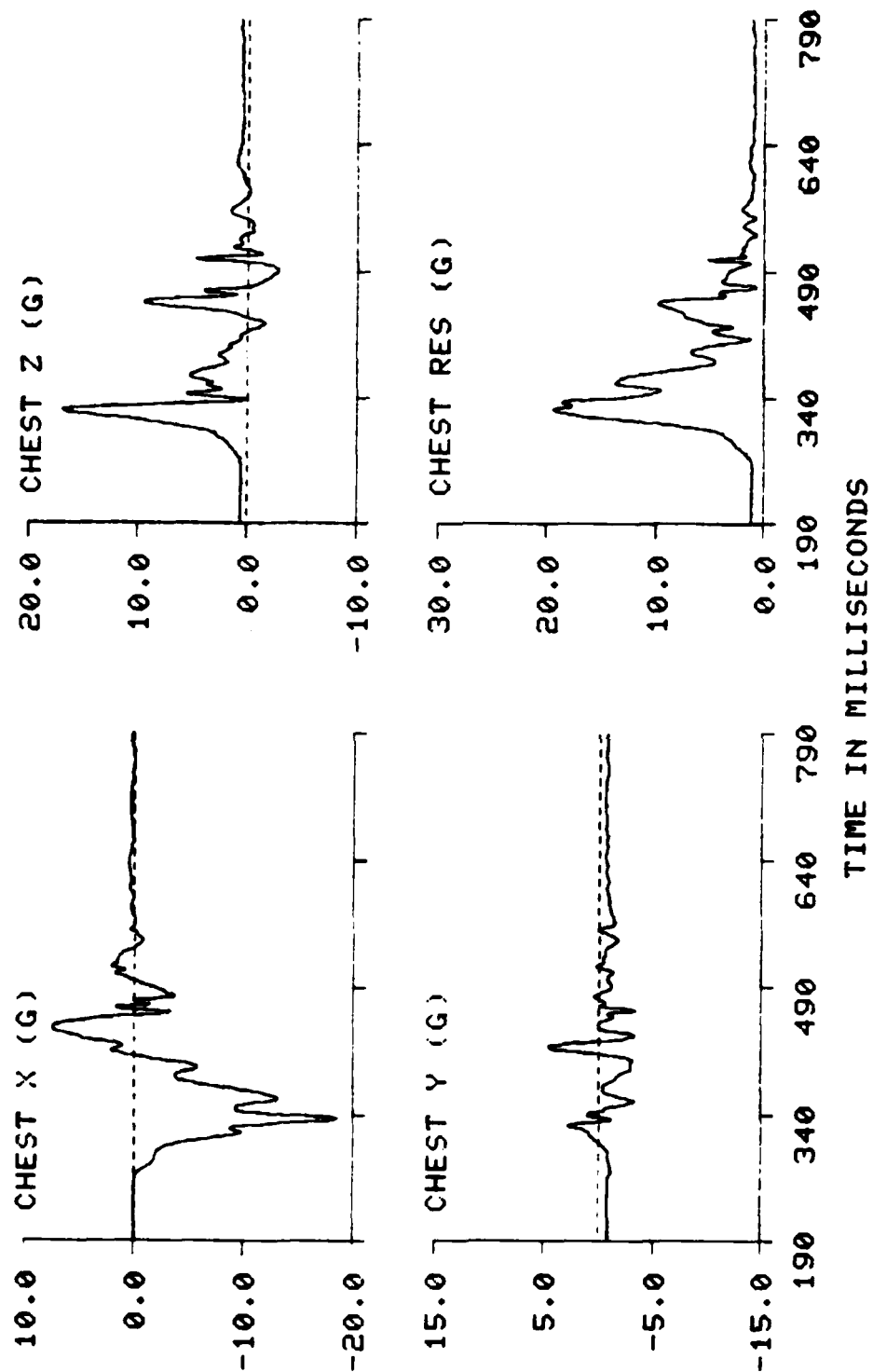
RESTRAINT CONFIGURATION STUDY      TEST NO: 2154      SUBJ ID: R-2



# RESTRAINT CONFIGURATION STUDY

TEST NO: 2154

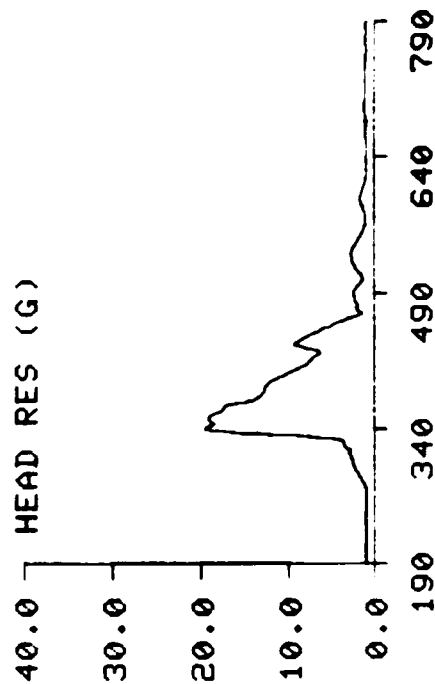
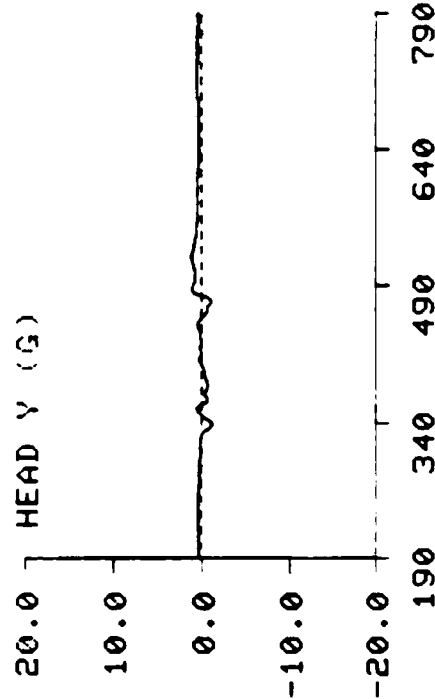
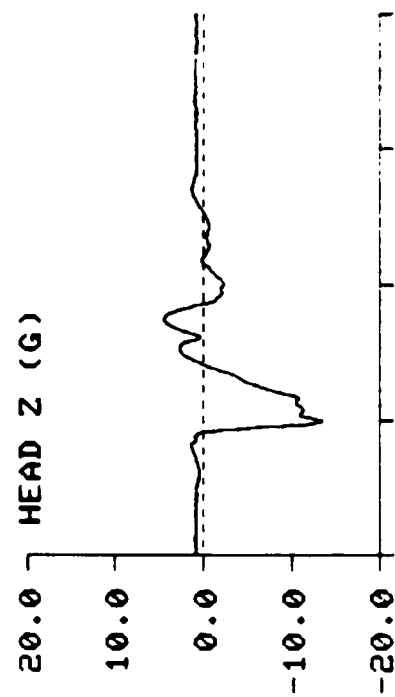
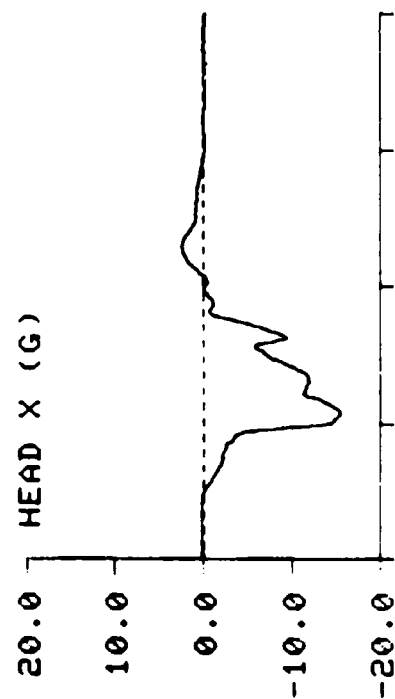
SUBJ ID: R-2



# RESTRAINT CONFIGURATION STUDY

TEST NO: 2154

SUBJ ID: R-2



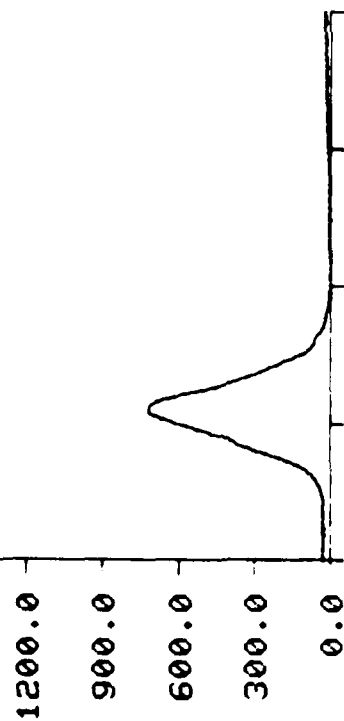
TIME IN MILLISECONDS

# RESTRAINT CONFIGURATION STUDY

TEST NO: 2154

SUBJ ID: R-2

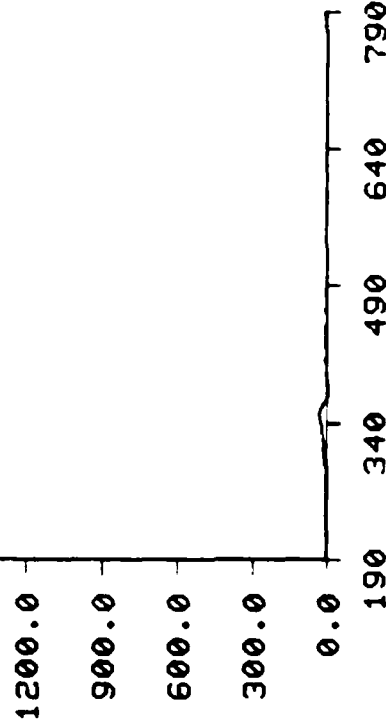
SHOULDER X (LB)



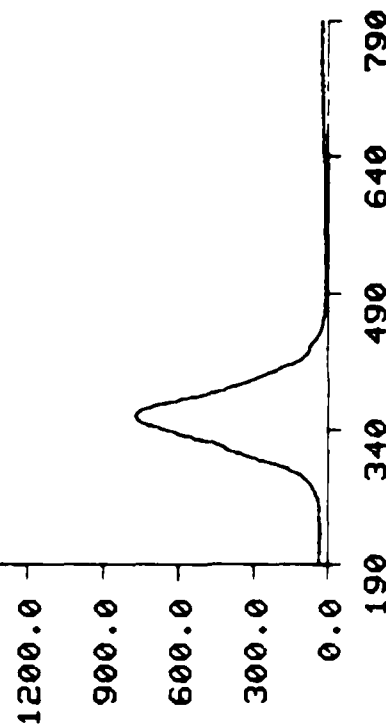
SHOULDER Z (LB)



SHOULDER Y (LB)

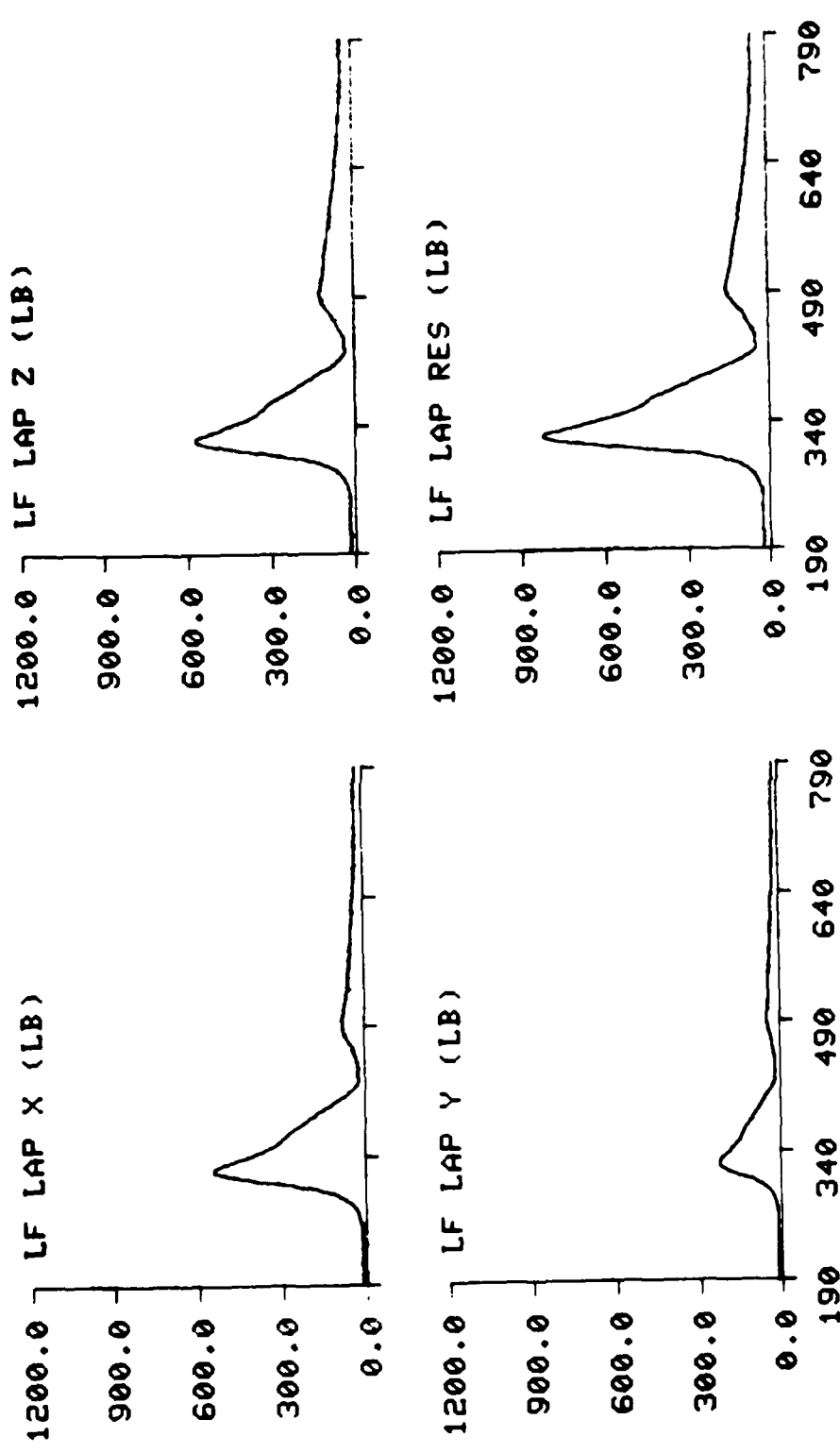


SHOULDER RES (LB)



TIME IN MILLISECONDS

RESTRAINT CONFIGURATION STUDY      TEST NO: 2154      SUBJ ID: R-2

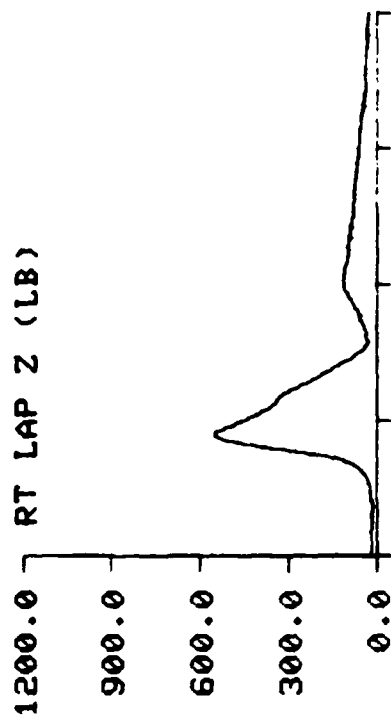


# RESTRAINT CONFIGURATION STUDY

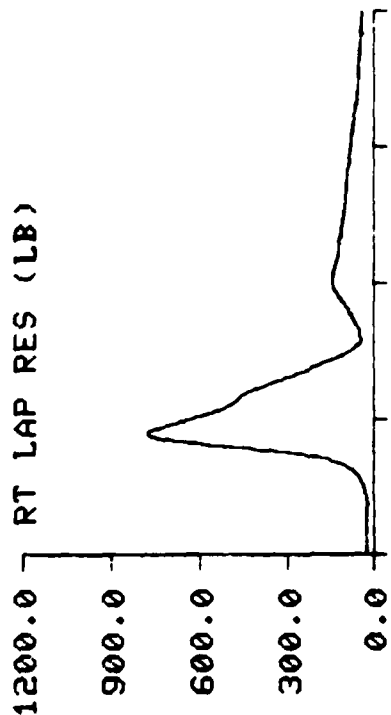
TEST NO: 2154

SUBJ ID: R-2

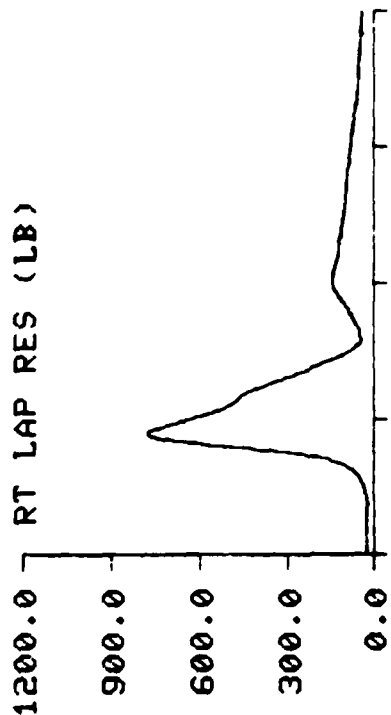
RT LAP X (LB)



RT LAP Y (LB)

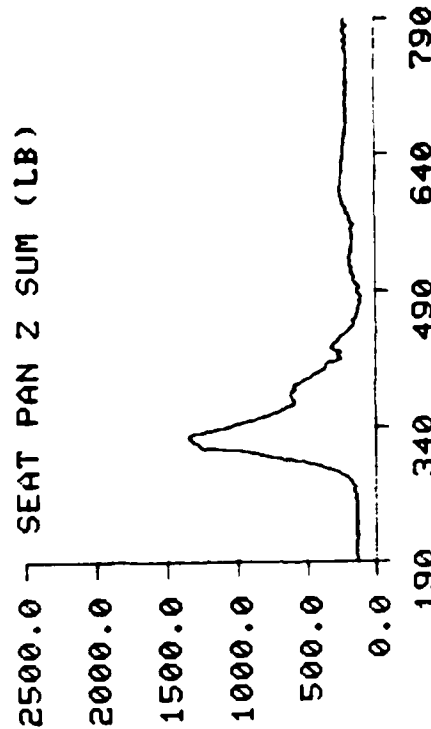
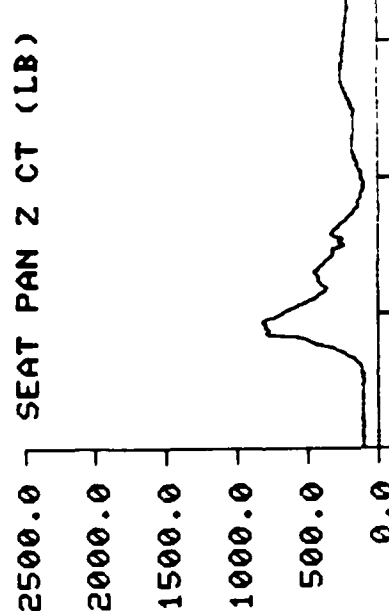
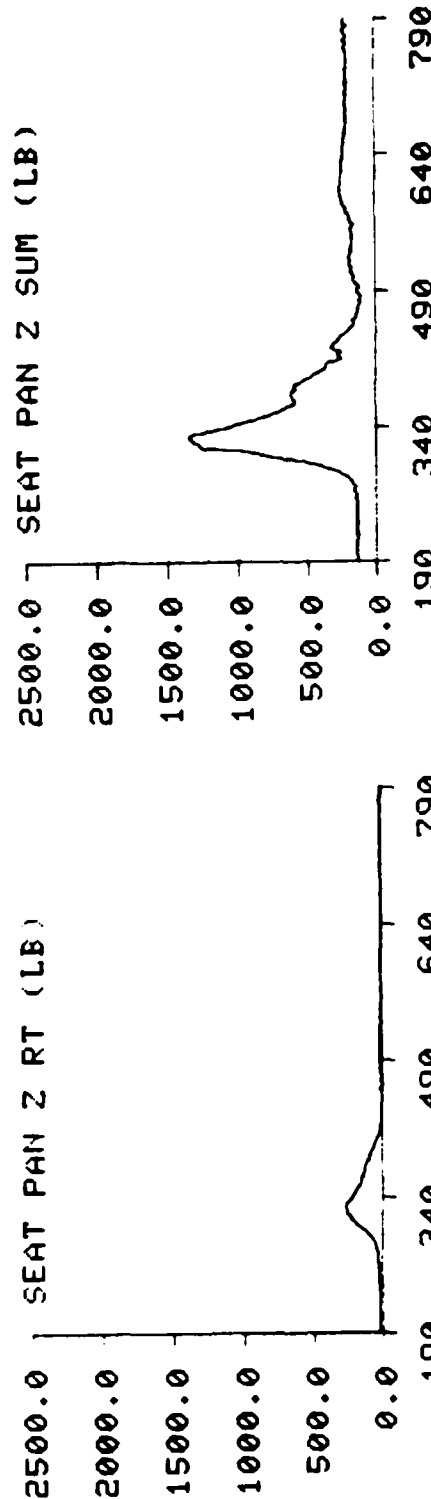
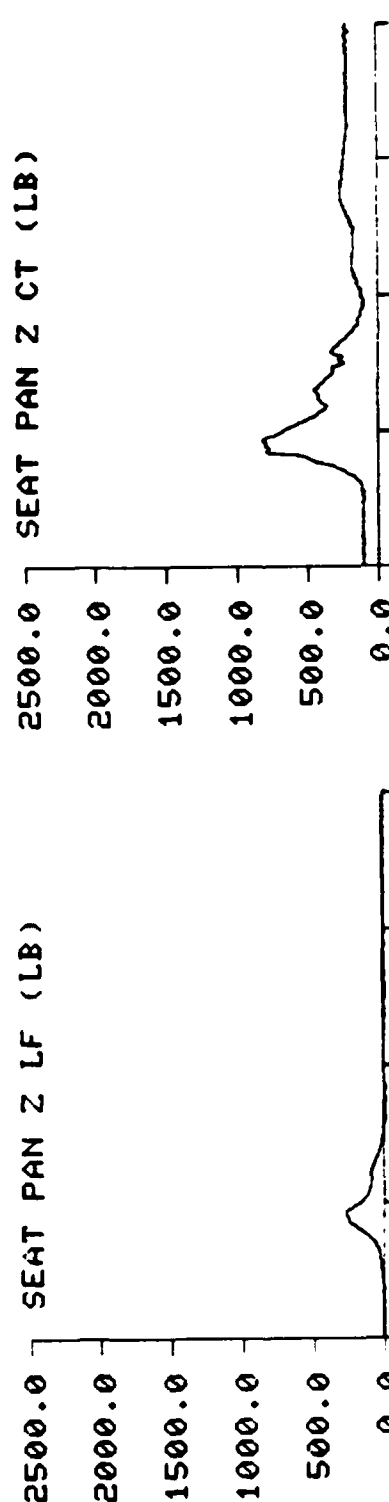


RT LAP RES (LB)



TIME IN MILLISECONDS

RESTRAINT CONFIGURATION STUDY      TEST NO: 2154      SUBJ ID: R-2



TIME IN MILLISECONDS



HORIZONTAL TEST PHASE		TEST: 2108	SUBJ: 8-2	WT: 188.0	CELL: B
PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			209		
TIME OF IMPACT START			276		
SLED ACCELERATION (G)					
X AXIS		0.60	446	-9.57	322
X AXIS (SMOOTHED)		0.50	447	-9.50	324
Y AXIS		0.48	330	-0.51	527
Z AXIS		1.89	446	0.09	340
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	258	-29.77	425
TACHOMETER (MEASURED)		0.22	275	-29.99	449
SEAT ACCELERATION (G)					
X AXIS		0.79	434	-10.19	328
X AXIS (SMOOTHED)		0.65	433	-9.93	327
Y AXIS		0.97	460	-0.59	454
Z AXIS		2.80	332	-0.93	327
CHEST ACCELERATION (G)					
X AXIS		8.77	485	-28.64	352
Y AXIS		1.89	405	-3.28	371
Z AXIS		20.39	358	-4.64	484
RESULTANT		31.96	354	0.41	584
CHEST SEVERITY INDEX		99.33			
HEAD ACCELERATION (G)					
X AXIS		3.93	502	-11.13	409
Y AXIS		0.37	520	-2.07	437
Z AXIS		7.32	484	-11.28	375
RESULTANT		14.34	375	0.40	590
HEAD SEVERITY INDEX		50.84			
NEGATIVE G STRAP		224.76	533	-5.57	309
SHOULDER STRAP LOADS (LB)					
X AXIS	38.62	748.46	362	-4.63	468
Y AXIS	2.05	31.29	348	-0.70	542
Z AXIS	13.92	271.33	362	-3.60	472
RESULTANT	41.23	796.43	362	1.90	475
LEFT LAP LOADS (LB)					
X AXIS	15.59	984.76	353	7.89	274
Y AXIS	4.53	252.34	352	0.16	212
Z AXIS	22.75	897.91	352	17.25	233
RESULTANT	28.07	1354.56	352	23.56	233
RIGHT LAP LOADS (LB)					
X AXIS	16.68	920.68	352	3.92	203
Y AXIS	5.81	258.45	354	-1.62	288
Z AXIS	24.82	933.12	352	18.09	226
RESULTANT	30.25	1335.61	352	24.92	226
TOTAL LAP LOAD (LB)	58.31	2690.17	352	53.08	233
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-72.13	-8.15	356	-122.76	493
SEAT LOADS (LB)					
Z AXIS (LEFT)	20.22	480.44	365	-14.50	532
Z AXIS (RIGHT)	18.57	503.57	356	-0.24	783
Z AXIS (CENTER)	163.98	1097.39	356	143.03	281
Z AXIS (SUM)	202.77	2052.46	356	193.91	217

HORIZONTAL TEST PHASE

TEST: 2141

SUBJ: B-1

WT: 147.0

CELL: B

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			173		
TIME OF IMPACT START			245		
SLED ACCELERATION (G)					
X AXIS		0.56	397	-9.68	293
X AXIS (SMOOTHED)		0.44	399	-9.59	297
Y AXIS		0.47	300	-0.54	489
Z AXIS		2.24	415	0.17	296
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	192	-30.15	394
TACHOMETER (MEASURED)		0.12	204	-30.39	417
SEAT ACCELERATION (G)					
X AXIS		0.72	403	-10.33	297
X AXIS (SMOOTHED)		0.62	402	-10.07	296
Y AXIS		0.70	429	-0.67	434
Z AXIS		2.69	301	-0.97	296
CHEST ACCELERATION (G)					
X AXIS		8.05	454	-19.81	322
Y AXIS		1.71	458	-3.36	443
Z AXIS		13.75	317	-4.32	454
RESULTANT		22.82	321	0.40	528
CHEST SEVERITY INDEX		58.55			
HEAD ACCELERATION (G)					
X AXIS		4.86	460	-15.06	331
Y AXIS		1.51	532	-1.74	468
Z AXIS		7.36	457	-13.57	319
RESULTANT		16.52	322	0.49	769
HEAD SEVERITY INDEX		70.34			
NEGATIVE G STRAP		94.42	452	-5.37	271
SHOULDER STRAP LOADS (LB)					
X AXIS	27.16	584.96	361	-2.10	437
Y AXIS	1.91	23.54	336	-3.78	528
Z AXIS	10.22	189.00	325	-5.64	450
RESULTANT	29.16	611.43	361	1.10	456
LEFT LAP LOADS (LB)					
X AXIS	29.70	569.25	313	9.28	727
Y AXIS	13.18	198.27	313	4.74	729
Z AXIS	41.92	565.45	313	17.53	764
RESULTANT	53.08	626.49	313	25.92	770
RIGHT LAP LOADS (LB)					
X AXIS	27.03	563.32	312	15.77	209
Y AXIS	12.76	225.19	311	6.98	185
Z AXIS	34.75	588.36	312	20.06	770
RESULTANT	45.98	645.11	312	30.84	770
TOTAL LAP LOAD (LB)	99.06	1668.50	313	56.77	770
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-67.55	40.79	748	-175.36	478
SEAT LOADS (LB)					
Z AXIS (LEFT)	21.50	207.54	314	-14.80	584
Z AXIS (RIGHT)	21.85	343.20	316	-13.41	566
Z AXIS (CENTER)	150.84	768.20	314	132.99	437
Z AXIS (SUM)	194.19	1314.38	314	116.94	438

HORIZONTAL TEST PHASE

TEST: 2091

SUBJ: 8-3

WT: 181.0

CELL: 8

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			188		
TIME OF IMPACT START			248		
SLED ACCELERATION (G)					
X AXIS		0.62	402	-9.36	302
X AXIS (SMOOTHED)		0.50	420	-9.31	301
Y AXIS		0.48	302	-0.67	492
Z AXIS		2.01	419	0.09	298
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	234	-29.69	398
TACHOMETER (MEASURED)		0.16	210	-29.99	424
SEAT ACCELERATION (G)					
X AXIS		0.80	407	-10.15	298
X AXIS (SMOOTHED)		0.65	406	-9.81	298
Y AXIS		1.00	433	-0.64	427
Z AXIS		3.13	303	-1.18	298
CHEST ACCELERATION (G)					
X AXIS		7.62	455	-21.61	321
Y AXIS		2.69	339	-2.88	443
Z AXIS		17.17	326	-2.79	456
RESULTANT		25.25	323	0.58	415
CHEST SEVERITY INDEX		63.71			
HEAD ACCELERATION (G)					
X AXIS		4.81	459	-12.64	334
Y AXIS		2.51	346	-0.63	468
Z AXIS		7.72	453	-6.51	488
RESULTANT		14.19	334	0.11	688
HEAD SEVERITY INDEX		47.90			
NEGATIVE G STRAP		138.46	491	8.55	268
SHOULDER STRAP LOADS (LB)					
X AXIS	30.72	635.72	333	1.23	441
Y AXIS	3.64	41.76	327	-7.20	529
Z AXIS	12.80	263.89	333	-8.61	460
RESULTANT	33.53	689.44	333	3.48	445
LEFT LAP LOADS (LB)					
X AXIS	43.56	764.47	323	9.62	707
Y AXIS	17.83	237.26	322	5.02	752
Z AXIS	54.67	698.55	323	17.14	697
RESULTANT	72.24	1062.39	323	26.03	697
RIGHT LAP LOADS (LB)					
X AXIS	44.10	721.86	323	21.10	692
Y AXIS	13.14	205.78	324	5.33	687
Z AXIS	55.97	712.49	322	37.50	682
RESULTANT	72.49	1033.01	323	48.32	682
TOTAL LAP LOAD (LB)	144.73	2095.40	323	83.81	682
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	15.36	54.80	709	-165.08	451
SEAT LOADS (LB)					
Z AXIS (LEFT)	35.39	452.36	322	-15.17	461
Z AXIS (RIGHT)	56.94	501.93	321	-3.40	720
Z AXIS (CENTER)	182.69	804.76	319	169.55	263
Z AXIS (SUM)	275.02	1749.80	321	198.56	489

HORIZONTAL TEST PHASE

TEST: 2161

SUBJ: C-1

WT: 168.0

CELL: 8

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			233		
TIME OF IMPACT START			298		
SLED ACCELERATION (G)					
X AXIS		0.64	453	-9.63	354
X AXIS (SMOOTHED)		0.49	455	-9.55	354
Y AXIS		0.51	353	-0.60	534
Z AXIS		2.27	471	0.11	349
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION	0.00	250		-29.94	449
TACHOMETER (MEASURED)	0.22	263		-30.11	470
SEAT ACCELERATION (G)					
X AXIS		0.75	459	-10.28	351
X AXIS (SMOOTHED)		0.64	457	-10.00	350
Y AXIS		1.10	485	0.02	406
Z AXIS		3.18	354	-0.61	349
CHEST ACCELERATION (G)					
X AXIS		8.28	497	-18.14	370
Y AXIS		0.82	497	-3.01	397
Z AXIS		12.21	364	-3.98	520
RESULTANT		20.36	369	0.49	620
CHEST SEVERITY INDEX		55.04			
HEAD ACCELERATION (G)					
X AXIS		1.00	577	-14.91	403
Y AXIS		1.39	576	-2.26	446
Z AXIS		8.92	492	-17.64	400
RESULTANT		22.80	401	0.14	746
HEAD SEVERITY INDEX		65.69			
NEGATIVE G STRAP		164.54	520	12.66	339
SHOULDER STRAP LOADS (LB)					
X AXIS	33.05	675.68	386	1.66	491
Y AXIS	6.72	34.32	372	-14.64	410
Z AXIS	7.30	195.23	385	-6.72	483
RESULTANT	34.58	703.59	387	3.45	491
LEFT LAP LOADS (LB)					
X AXIS	37.84	728.06	370	17.61	721
Y AXIS	11.92	230.59	373	4.22	723
Z AXIS	46.54	687.87	370	28.37	718
RESULTANT	61.19	1027.56	370	39.15	718
RIGHT LAP LOADS (LB)					
X AXIS	31.19	678.10	370	25.07	241
Y AXIS	12.53	233.94	372	5.59	290
Z AXIS	44.07	686.56	369	34.14	292
RESULTANT	55.51	992.63	370	49.01	292
TOTAL LAP LOAD (LB)	116.71	2020.19	370	94.19	718
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-83.04	-0.12	374	-85.45	259
SEAT LOADS (LB)					
Z AXIS (LEFT)	60.37	457.11	374	-4.33	574
Z AXIS (RIGHT)	54.23	421.35	372	-6.59	486
Z AXIS (CENTER)	114.58	916.74	370	104.92	307
Z AXIS (SUM)	229.19	1779.93	371	221.77	270

HORIZONTAL TEST PHASE

TEST: 2123

SUBJ: C-2

WT: 187.0

CELL: 8

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			221		
TIME OF IMPACT START			288		
SLED ACCELERATION (G)					
X AXIS		0.52	442	-9.56	334
X AXIS (SMOOTHED)		0.46	459	-9.50	337
Y AXIS		0.49	339	-0.33	567
Z AXIS		1.41	473	0.19	355
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	223	-29.51	438
TACHOMETER (MEASURED)		0.16	220	-29.76	463
SEAT ACCELERATION (G)					
X AXIS		0.71	448	-10.04	343
X AXIS (SMOOTHED)		0.57	446	-9.82	341
Y AXIS		0.85	451	-0.78	390
Z AXIS		2.31	347	-1.00	342
CHEST ACCELERATION (G)					
X AXIS		7.01	513	-27.05	364
Y AXIS		3.19	362	-1.86	513
Z AXIS		27.25	370	-2.62	538
RESULTANT		35.80	370	0.38	632
CHEST SEVERITY INDEX		111.68			
HEAD ACCELERATION (G)					
X AXIS		3.37	524	-20.44	375
Y AXIS		2.62	376	-0.95	540
Z AXIS		6.82	447	-10.84	366
RESULTANT		22.39	374	0.31	669
HEAD SEVERITY INDEX		96.19			
NEGATIVE G STRAP		152.71	587	0.83	300
SHOULDER STRAP LOADS (LB)					
X AXIS	11.82	797.40	374	-11.03	514
Y AXIS	0.34	21.02	416	-5.17	580
Z AXIS	6.23	305.01	372	-8.86	495
RESULTANT	13.66	852.03	374	1.32	534
LEFT LAP LOADS (LB)					
X AXIS	10.41	988.46	364	1.73	242
Y AXIS	2.96	285.44	365	0.42	221
Z AXIS	11.64	896.60	365	5.98	270
RESULTANT	16.05	1364.70	365	12.39	242
RIGHT LAP LOADS (LB)					
X AXIS	8.04	927.92	364	-1.41	249
Y AXIS	0.86	245.87	365	-4.06	228
Z AXIS	9.56	892.83	364	4.47	238
RESULTANT	12.81	1310.96	365	9.78	236
TOTAL LAP LOAD (LB)	28.85	2675.66	365	23.53	231
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	44.45	83.19	369	13.43	743
SEAT LOADS (LB)					
Z AXIS (LEFT)	22.29	520.46	367	-7.98	639
Z AXIS (RIGHT)	32.69	519.07	364	3.13	534
Z AXIS (CENTER)	128.59	973.64	369	106.03	307
Z AXIS (SUM)	183.57	2003.99	365	153.51	547

HORIZONTAL TEST PHASE

TEST: 2064

SUBJ: F-2

WT: 154.0

CELL: B

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			168		
TIME OF IMPACT START			252		
SLED ACCELERATION (G)					
X AXIS		0.53	406	-9.62	301
X AXIS (SMOOTHED)		0.40	407	-8.54	303
Y AXIS		0.47	307	-0.41	494
Z AXIS		1.02	422	0.15	303
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	222	-30.04	402
TACHOMETER (MEASURED)		0.17	207	-30.28	423
SEAT ACCELERATION (G)					
X AXIS		0.78	407	-10.33	305
X AXIS (SMOOTHED)		0.58	409	-9.99	304
Y AXIS		0.40	501	-0.73	359
Z AXIS		2.67	309	-0.79	303
CHEST ACCELERATION (G)					
X AXIS		8.33	454	-21.92	327
Y AXIS		2.14	317	-1.56	404
Z AXIS		12.29	320	-5.24	470
RESULTANT		23.62	326	0.25	557
CHEST SEVERITY INDEX		58.31			
HEAD ACCELERATION (G)					
X AXIS		2.44	464	-16.42	329
Y AXIS		1.99	450	0.09	330
Z AXIS		5.75	447	-13.33	326
RESULTANT		20.22	328	1.11	609
HEAD SEVERITY INDEX		72.96			
NEGATIVE G STRAP		160.04	478	-1.88	284
SHOULDER STRAP LOADS (LB)					
X AXIS	33.64	658.01	331	-0.20	468
Y AXIS	2.25	30.49	318	-4.80	345
Z AXIS	12.99	265.15	334	-0.05	465
RESULTANT	36.29	708.78	331	4.90	468
LEFT LAP LOADS (LB)					
X AXIS	25.56	727.12	327	16.68	206
Y AXIS	11.03	258.60	327	5.25	208
Z AXIS	30.21	637.26	329	19.61	746
RESULTANT	41.11	1000.84	329	33.84	746
RIGHT LAP LOADS (LB)					
X AXIS	24.61	743.76	327	15.37	219
Y AXIS	4.69	164.80	329	-1.40	221
Z AXIS	31.47	719.67	328	24.17	223
RESULTANT	40.28	1047.78	328	35.42	223
TOTAL LAP LOAD (LB)	81.39	2046.09	328	75.90	210
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	62.31	68.94	324	33.44	557
SEAT LOADS (LB)					
Z AXIS (LEFT)	15.26	262.82	330	-5.21	770
Z AXIS (RIGHT)	36.75	406.23	325	16.24	698
Z AXIS (CENTER)	117.99	799.80	325	102.63	193
Z AXIS (SUM)	170.01	1459.72	325	154.70	193

HORIZONTAL TEST PHASE		TEST: 2079	SUBJ: G-3	WT: 165.0	CELL: B
PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			178		
TIME OF IMPACT START			236		
SLED ACCELERATION (G)					
X AXIS		0.58	390	-9.52	283
X AXIS (SMOOTHED)		0.48	407	-9.44	285
Y AXIS		0.48	312	-0.61	477
Z AXIS		2.13	406	0.21	302
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	213	-29.71	386
TACHOMETER (MEASURED)		0.17	202	-30.04	415
SEAT ACCELERATION (G)					
X AXIS		0.79	392	-9.97	290
X AXIS (SMOOTHED)		0.62	393	-9.79	288
Y AXIS		0.97	420	-0.67	335
Z AXIS		2.68	421	-0.64	288
CHEST ACCELERATION (G)					
X AXIS		7.53	448	-25.45	310
Y AXIS		1.70	312	-3.56	335
Z AXIS		12.24	319	-5.87	468
RESULTANT		25.74	310	0.55	557
CHEST SEVERITY INDEX		64.76			
HEAD ACCELERATION (G)					
X AXIS		4.70	456	-13.36	354
Y AXIS		1.09	540	-4.13	354
Z AXIS		5.07	434	-17.87	327
RESULTANT		20.99	328	0.32	763
HEAD SEVERITY INDEX		67.24			
NEGATIVE G STRAP		197.83	468	-3.63	271
SHOULDER STRAP LOADS (LB)					
X AXIS	32.81	700.35	324	-5.30	444
Y AXIS	1.27	15.48	355	-5.01	396
Z AXIS	14.94	277.32	323	-4.91	466
RESULTANT	36.15	753.29	324	0.78	448
LEFT LAP LOADS (LB)					
X AXIS	13.76	828.51	311	4.59	209
Y AXIS	6.90	290.41	309	3.05	170
Z AXIS	18.17	709.63	309	10.28	214
RESULTANT	23.98	1127.62	311	16.01	765
RIGHT LAP LOADS (LB)					
X AXIS	15.22	844.88	310	8.49	175
Y AXIS	4.01	223.59	309	-2.23	194
Z AXIS	19.61	788.15	308	12.64	188
RESULTANT	25.28	1176.86	310	21.11	188
TOTAL LAP LOAD (LB)	49.26	2303.92	310	41.26	214
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-6.17	7.74	308	-46.45	644
SEAT LOADS (LB)					
Z AXIS (LEFT)	23.57	395.95	312	-12.18	662
Z AXIS (RIGHT)	26.62	455.04	311	4.34	439
Z AXIS (CENTER)	112.23	918.98	310	97.85	185
Z AXIS (SUM)	162.42	1765.34	311	146.89	455

HORIZONTAL TEST PHASE

TEST: 2162

SUBJ: J-3

WT: 166.0

CELL: 8

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			174		
TIME OF IMPACT START			239		
SLED ACCELERATION (G)					
X AXIS		0.61	394	-9.61	293
X AXIS (SMOOTHED)		0.48	396	-9.58	295
Y AXIS		0.47	293	-0.51	486
Z AXIS		2.32	413	0.06	289
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	211	-29.98	391
TACHOMETER (MEASURED)		0.17	193	-30.16	417
SEAT ACCELERATION (G)					
X AXIS		0.74	401	-10.29	291
X AXIS (SMOOTHED)		0.59	399	-9.98	291
Y AXIS		0.04	426	-1.14	421
Z AXIS		3.02	294	-1.40	289
CHEST ACCELERATION (G)					
X AXIS		8.53	436	-15.26	317
Y AXIS		0.78	439	-2.84	322
Z AXIS		15.40	322	-2.84	449
RESULTANT		20.95	320	0.59	552
CHEST SEVERITY INDEX		48.08			
HEAD ACCELERATION (G)					
X AXIS		3.33	445	-9.10	371
Y AXIS		1.41	490	-0.97	421
Z AXIS		11.57	433	-7.43	348
RESULTANT		11.62	349	0.44	249
HEAD SEVERITY INDEX		37.50			
NEGATIVE G STRAP		77.28	463	6.99	273
SHOULDER STRAP LOADS (LB)					
X AXIS	70.76	549.26	325	1.74	427
Y AXIS	-0.89	24.80	324	-7.08	509
Z AXIS	19.90	194.40	324	-0.24	422
RESULTANT	73.54	582.37	325	8.78	432
LEFT LAP LOADS (LB)					
X AXIS	43.47	636.69	310	24.91	429
Y AXIS	22.75	235.10	309	11.07	439
Z AXIS	60.09	592.79	311	32.91	429
RESULTANT	77.62	699.22	310	49.06	426
RIGHT LAP LOADS (LB)					
X AXIS	44.36	601.25	310	26.07	427
Y AXIS	12.43	152.39	315	3.93	430
Z AXIS	64.05	619.14	310	36.43	429
RESULTANT	78.93	875.95	310	45.74	427
TOTAL LAP LOAD (LB)	156.55	1775.16	310	88.80	428
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	63.53	71.26	501	33.26	767
SEAT LOADS (LB)					
Z AXIS (LEFT)	56.99	388.91	315	-11.60	418
Z AXIS (RIGHT)	100.24	527.39	312	-8.29	507
Z AXIS (CENTER)	94.32	678.71	317	77.59	249
Z AXIS (SUM)	251.55	1573.77	317	26.96	454



HORIZONTAL TEST PHASE

TEST: 2110

SUBJ: J-4

WT: 180.0

CELL: B

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			192		
TIME OF IMPACT START			251		
SLED ACCELERATION (G)					
X AXIS		0.61	405	-9.54	303
X AXIS (SMOOTHED)		0.48	424	-9.41	303
Y AXIS		0.48	313	-0.44	503
Z AXIS		2.14	423	-0.32	299
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	239	-29.72	401
TACHOMETER (MEASURED)		0.16	205	-30.05	428
SEAT ACCELERATION (G)					
X AXIS		0.76	411	-10.16	300
X AXIS (SMOOTHED)		0.60	410	-9.81	301
Y AXIS		0.84	437	-0.86	442
Z AXIS		3.66	305	-1.81	300
CHEST ACCELERATION (G)					
X AXIS		12.90	455	-17.78	328
Y AXIS		0.75	340	-3.81	351
Z AXIS		13.18	316	-4.62	495
RESULTANT		19.15	330	0.63	582
CHEST SEVERITY INDEX		57.86			
HEAD ACCELERATION (G)					
X AXIS		2.29	452	-9.42	321
Y AXIS		0.64	340	-0.83	442
Z AXIS		7.33	445	-0.71	367
RESULTANT		10.41	326	0.27	226
HEAD SEVERITY INDEX		42.23			
NEGATIVE G STRAP		117.29	544	1.81	294
SHOULDER STRAP LOADS (LB)					
X AXIS	40.84	605.83	335	2.96	442
Y AXIS	-0.59	24.87	324	-7.01	461
Z AXIS	7.54	158.68	337	-6.76	789
RESULTANT	41.61	625.42	335	4.69	445
LEFT LAP LOADS (LB)					
X AXIS	42.53	874.84	323	8.98	764
Y AXIS	16.49	246.29	325	4.67	760
Z AXIS	60.49	834.36	323	19.45	790
RESULTANT	75.83	1233.29	324	28.65	790
RIGHT LAP LOADS (LB)					
X AXIS	42.35	832.22	323	10.90	729
Y AXIS	12.84	226.73	324	3.45	725
Z AXIS	59.46	838.91	322	20.31	761
RESULTANT	74.16	1200.86	323	30.07	761
TOTAL LAP LOAD (LB)	149.98	2433.91	323	64.87	761
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	89.45	155.85	328	-63.41	456
SEAT LOADS (LB)					
Z AXIS (LEFT)	47.18	508.19	329	-14.16	429
Z AXIS (RIGHT)	70.29	521.41	328	-12.75	643
Z AXIS (CENTER)	146.13	1131.48	328	133.73	227
Z AXIS (SUM)	263.60	2159.56	330	149.86	479

HORIZONTAL TEST PHASE      TEST: 2144      SUBJ: K-1      WT: 179.0      CELL: 8

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			222		
TIME OF IMPACT START			287		
SLED ACCELERATION (G)					
X AXIS		0.61	440	-9.63	341
X AXIS (SMOOTHED)		0.49	442	-9.58	340
Y AXIS		0.49	341	-0.41	537
Z AXIS		2.29	458	0.16	350
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	276	-29.98	436
TACHOMETER (MEASURED)		0.17	273	-30.22	463
SEAT ACCELERATION (G)					
X AXIS		0.77	447	-10.35	338
X AXIS (SMOOTHED)		0.61	445	-10.08	338
Y AXIS		1.03	473	-0.59	478
Z AXIS		2.90	342	-1.05	337
CHEST ACCELERATION (G)					
X AXIS		5.87	505	-20.44	368
Y AXIS		1.86	497	-1.65	469
Z AXIS		18.12	369	-4.68	528
RESULTANT		27.27	369	0.48	619
CHEST SEVERITY INDEX		65.17			
HEAD ACCELERATION (G)					
X AXIS		3.32	509	-10.56	370
Y AXIS		1.02	516	-1.55	407
Z AXIS		5.93	495	-13.19	386
RESULTANT		15.96	386	0.42	289
HEAD SEVERITY INDEX		41.70			
NEGATIVE G STRAP		95.65	520	3.39	776
SHOULDER STRAP LOADS (LB)					
X AXIS	47.24	799.14	371	4.55	480
Y AXIS	0.57	22.52	378	-7.08	445
Z AXIS	17.23	289.05	373	-5.35	486
RESULTANT	50.40	849.25	372	6.37	489
LEFT LAP LOADS (LB)					
X AXIS	36.41	793.93	363	11.94	712
Y AXIS	11.78	233.27	365	2.20	790
Z AXIS	46.14	731.78	364	20.48	724
RESULTANT	59.99	1104.40	364	30.99	777
RIGHT LAP LOADS (LB)					
X AXIS	36.67	759.73	363	13.76	802
Y AXIS	10.40	220.80	364	1.32	736
Z AXIS	47.84	754.26	363	21.83	761
RESULTANT	61.23	1092.08	363	33.20	761
TOTAL LAP LOAD (LB)	121.22	2195.75	364	65.73	761
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-67.76	-0.86	368	-69.38	239
SEAT LOADS (LB)					
Z AXIS (LEFT)	78.64	467.28	364	-1.77	579
Z AXIS (RIGHT)	59.43	497.98	366	-2.79	492
Z AXIS (CENTER)	91.90	869.52	366	73.19	302
Z AXIS (SUM)	229.97	1834.79	366	158.08	522

HORIZONTAL TEST PHASE

TEST: 2114

SUBJ: P-3

WT: 197.0

CELL: B

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			190		
TIME OF IMPACT START			251		
SLED ACCELERATION (G)					
X AXIS		0.58	405	-9.49	298
X AXIS (SMOOTHED)		0.48	423	-9.39	299
Y AXIS		0.51	305	-0.52	503
Z AXIS		2.04	422	0.08	301
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	226	-29.66	400
TACHOMETER (MEASURED)		0.22	197	-29.93	428
SEAT ACCELERATION (G)					
X AXIS		0.81	410	-10.10	303
X AXIS (SMOOTHED)		0.64	409	-9.86	302
Y AXIS		0.85	436	-0.77	430
Z AXIS		3.25	437	-1.09	301
CHEST ACCELERATION (G)					
X AXIS		5.17	471	-13.93	330
Y AXIS		3.33	381	-3.22	489
Z AXIS		16.48	337	-5.25	486
RESULTANT		20.94	337	0.44	599
CHEST SEVERITY INDEX		54.37			
HEAD ACCELERATION (G)					
X AXIS		2.86	503	-11.11	370
Y AXIS		1.69	344	-1.70	490
Z AXIS		2.02	478	-11.07	355
RESULTANT		14.25	958	0.26	783
HEAD SEVERITY INDEX		50.43			
NEGATIVE G STRAP		165.76	486	5.10	281
SHOULDER STRAP LOADS (LB)					
X AXIS	30.32	759.92	358	0.91	465
Y AXIS	0.34	37.55	330	-4.58	224
Z AXIS	4.33	144.77	332	-8.52	226
RESULTANT	30.79	771.88	358	1.88	470
LEFT LAP LOADS (LB)					
X AXIS	23.09	800.54	322	11.15	774
Y AXIS	8.19	223.02	324	1.34	776
Z AXIS	29.93	755.65	322	14.47	785
RESULTANT	38.74	1122.98	322	22.80	785
RIGHT LAP LOADS (LB)					
X AXIS	24.26	783.39	321	9.80	773
Y AXIS	7.69	229.30	321	0.94	211
Z AXIS	30.65	779.33	321	16.13	782
RESULTANT	39.89	1128.56	321	20.94	787
TOTAL LAP LOAD (LB)	78.63	2249.54	322	45.56	785
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	78.37	109.27	321	30.78	471
SEAT LOADS (LB)					
Z AXIS (LEFT)	46.75	482.24	323	-8.13	433
Z AXIS (RIGHT)	69.44	572.03	323	-7.65	606
Z AXIS (CENTER)	127.60	875.72	322	116.57	256
Z AXIS (SUM)	243.79	1929.99	323	142.11	482

HORIZONTAL TEST PHASE      TEST: 2076      SUBJ: R-2      WT: 142.0      CELL: B

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			204		
TIME OF IMPACT START			266		
SLED ACCELERATION (G)					
X AXIS		0.51	420	-9.59	313
X AXIS (SMOOTHED)		0.35	420	-9.52	314
Y AXIS		0.49	315	-0.31	511
Z AXIS		2.18	437	0.10	428
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	252	-30.11	415
TACHOMETER (MEASURED)		0.17	218	-30.51	439
SEAT ACCELERATION (G)					
X AXIS		0.88	421	-10.31	319
X AXIS (SMOOTHED)		0.56	422	-9.97	318
Y AXIS		0.67	450	-0.49	351
Z AXIS		2.88	423	-0.86	428
CHEST ACCELERATION (G)					
X AXIS		9.98	449	-26.86	339
Y AXIS		2.42	414	-4.38	346
Z AXIS		17.74	347	-6.06	408
RESULTANT		27.25	339	0.79	555
CHEST SEVERITY INDEX		88.87			
HEAD ACCELERATION (G)					
X AXIS		1.64	518	-17.79	353
Y AXIS		0.05	522	-2.61	343
Z AXIS		2.32	456	-16.91	341
RESULTANT		21.94	342	0.16	551
HEAD SEVERITY INDEX		67.11			
NEGATIVE G STRAP		112.34	517	-4.39	279
SHOULDER STRAP LOADS (LB)					
X AXIS	23.05	724.50	361	-0.91	652
Y AXIS	0.61	33.85	345	-7.04	462
Z AXIS	10.90	292.26	356	-9.44	657
RESULTANT	25.61	778.69	361	5.41	652
LEFT LAP LOADS (LB)					
X AXIS	10.61	604.03	331	-0.35	200
Y AXIS	6.99	219.33	333	4.69	219
Z AXIS	12.75	549.36	332	3.43	230
RESULTANT	18.29	845.43	333	13.97	205
RIGHT LAP LOADS (LB)					
X AXIS	11.25	595.47	334	5.22	224
Y AXIS	5.13	194.31	331	-1.07	235
Z AXIS	12.35	562.27	332	6.28	204
RESULTANT	17.67	839.65	332	13.69	204
TOTAL LAP LOAD (LB)	35.97	1684.77	332	29.67	246
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-62.60	136.50	447	-146.29	504
SEAT LOADS (LB)					
Z AXIS (LEFT)	27.62	263.73	326	-16.48	474
Z AXIS (RIGHT)	7.95	267.87	339	-12.87	669
Z AXIS (CENTER)	101.39	771.79	338	90.11	209
Z AXIS (SUM)	136.96	1254.67	338	126.17	251

HORIZONTAL TEST PHASE      TEST: 2163      SUBJ: R-3      WT: 153.0      CELL: B

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			201		
TIME OF IMPACT START			265		
SLED ACCELERATION (G)					
X AXIS		0.60	420	-9.71	319
X AXIS (SMOOTHED)		0.48	422	-9.64	321
Y AXIS		0.44	314	-0.40	520
Z AXIS		2.97	439	0.13	330
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	258	-30.04	416
TACHOMETER (MEASURED)		0.17	214	-30.22	437
SEAT ACCELERATION (G)					
X AXIS		0.84	426	-10.41	318
X AXIS (SMOOTHED)		0.60	425	-10.09	318
Y AXIS		0.88	454	-0.92	460
Z AXIS		4.23	455	-1.14	432
CHEST ACCELERATION (G)					
X AXIS		12.58	472	-19.68	342
Y AXIS		1.29	476	-1.54	456
Z AXIS		11.82	346	-6.98	501
RESULTANT		22.17	345	0.44	637
CHEST SEVERITY INDEX		63.51			
HEAD ACCELERATION (G)					
X AXIS		5.47	538	-10.40	343
Y AXIS		1.12	538	-1.25	363
Z AXIS		8.57	464	-2.78	506
RESULTANT		10.41	343	0.48	750
HEAD SEVERITY INDEX		29.87			
NEGATIVE G STRAP		116.78	500	-5.60	299
SHOULDER STRAP LOADS (LB)					
X AXIS	59.69	727.23	345	-6.09	464
Y AXIS	4.05	34.02	331	-4.69	458
Z AXIS	27.54	303.84	343	-5.16	469
RESULTANT	65.90	788.79	345	0.36	476
LEFT LAP LOADS (LB)					
X AXIS	31.62	682.28	343	1.43	786
Y AXIS	12.97	232.59	342	1.52	755
Z AXIS	41.48	650.21	343	8.65	791
RESULTANT	53.83	970.76	343	17.66	791
RIGHT LAP LOADS (LB)					
X AXIS	29.03	683.48	343	7.84	760
Y AXIS	12.28	238.10	343	0.86	796
Z AXIS	39.97	681.14	343	20.52	698
RESULTANT	50.96	993.87	343	26.63	799
TOTAL LAP LOAD (LB)	104.79	1964.63	343	48.47	799
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-59.81	27.77	512	-192.73	471
SEAT LOADS (LB)					
Z AXIS (LEFT)	9.44	222.89	343	-14.68	606
Z AXIS (RIGHT)	7.95	351.82	346	-9.35	445
Z AXIS (CENTER)	181.95	794.35	344	118.86	501
Z AXIS (SUM)	199.34	1361.46	345	122.29	496

HORIZONTAL TEST PHASE

TEST: 2096

SUBJ: T-1

WT: 168.0

CELL: B

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			222		
TIME OF IMPACT START			282		
SLED ACCELERATION (G)					
X AXIS		0.57	434	-9.57	330
X AXIS (SMOOTHED)		0.49	452	-9.53	332
Y AXIS		0.51	336	-0.62	516
Z AXIS		1.02	450	-0.15	332
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	269	-29.97	431
TACHOMETER (MEASURED)		0.04	225	-30.29	452
SEAT ACCELERATION (G)					
X AXIS		0.71	438	-10.17	333
X AXIS (SMOOTHED)		0.63	438	-9.95	333
Y AXIS		0.72	481	-0.64	388
Z AXIS		3.06	337	-1.22	332
CHEST ACCELERATION (G)					
X AXIS		7.60	485	-29.21	357
Y AXIS		2.05	478	-4.96	356
Z AXIS		10.08	341	-3.64	497
RESULTANT		30.91	357	0.15	596
CHEST SEVERITY INDEX		86.44			
HEAD ACCELERATION (G)					
X AXIS		3.73	492	-12.27	390
Y AXIS		1.68	367	-0.52	391
Z AXIS		8.90	484	-9.07	384
RESULTANT		14.85	367	0.44	818
HEAD SEVERITY INDEX		46.85			
NEGATIVE G STRAP		168.07	509	-3.89	317
SHOULDER STRAP LOADS (LB)					
X AXIS	48.94	805.19	370	-11.15	485
Y AXIS	2.19	29.19	343	-7.24	493
Z AXIS	22.29	315.22	368	-1.07	501
RESULTANT	53.89	863.99	370	1.48	501
LEFT LAP LOADS (LB)					
X AXIS	10.68	756.48	356	13.86	812
Y AXIS	9.24	220.27	356	5.63	785
Z AXIS	25.86	692.85	356	15.42	805
RESULTANT	33.88	1049.20	356	24.78	811
RIGHT LAP LOADS (LB)					
X AXIS	21.50	771.99	355	10.95	224
Y AXIS	7.79	239.45	356	6.01	224
Z AXIS	27.21	759.96	355	25.48	220
RESULTANT	35.60	1109.44	356	30.24	224
TOTAL LAP LOAD (LB)	69.48	2158.64	356	61.50	276
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	29.38	60.74	352	-55.11	726
SEAT LOADS (LB)					
Z AXIS (LEFT)	17.27	348.10	358	-14.35	629
Z AXIS (RIGHT)	26.68	505.84	357	-5.55	497
Z AXIS (CENTER)	136.65	842.63	353	123.76	285
Z AXIS (SUM)	180.59	1681.13	357	173.78	285

HORIZONTAL TEST PHASE

TEST: 2115

SUBJ: W-4

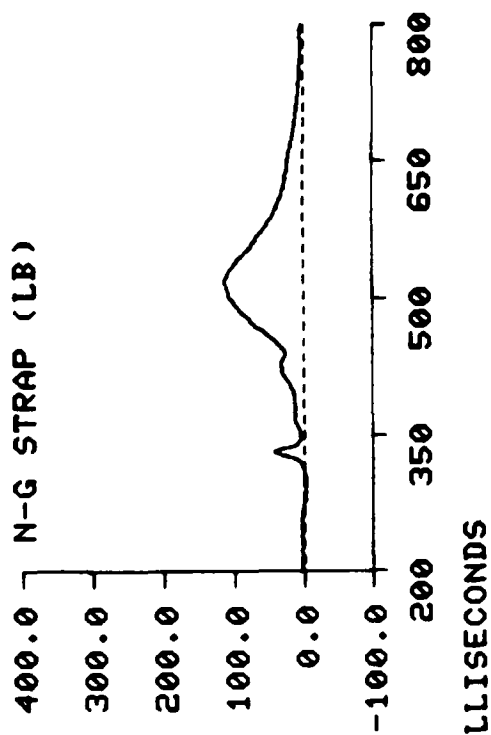
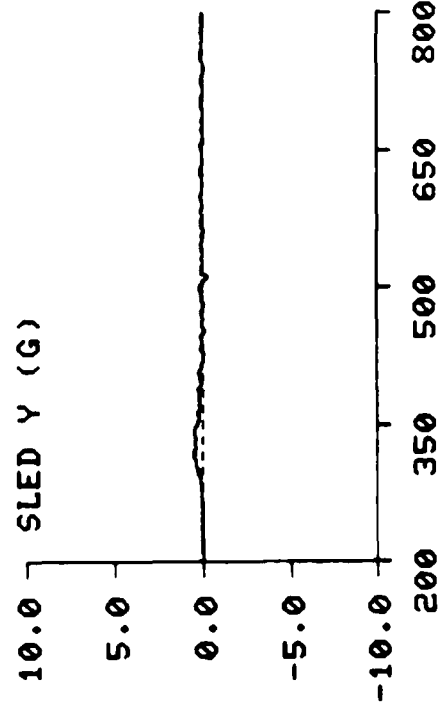
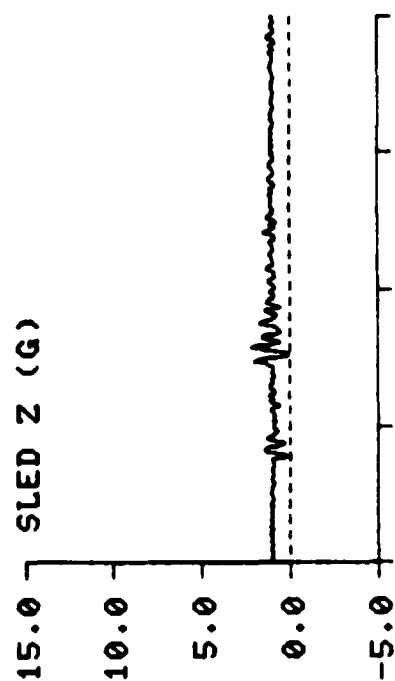
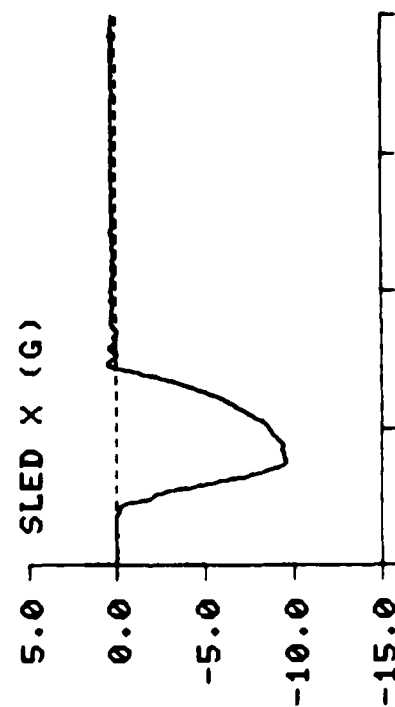
WT: 192.0

CELL: B

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			221		
TIME OF IMPACT START			283		
SLED ACCELERATION (G)					
X AXIS		0.62	437	-9.55	336
X AXIS (SMOOTHED)		0.48	456	-9.43	333
Y AXIS		0.48	346	-0.52	539
Z AXIS		2.09	455	0.13	447
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	220	-29.62	433
TACHOMETER (MEASURED)		0.22	270	-29.82	458
SEAT ACCELERATION (G)					
X AXIS		0.79	444	-10.12	336
X AXIS (SMOOTHED)		0.61	442	-9.88	335
Y AXIS		1.02	469	-0.57	464
Z AXIS		2.72	340	-0.83	334
CHEST ACCELERATION (G)					
X AXIS		9.73	495	-26.68	365
Y AXIS		2.21	403	-3.40	415
Z AXIS		23.92	371	-6.65	362
RESULTANT		33.30	370	0.56	616
CHEST SEVERITY INDEX		91.00			
HEAD ACCELERATION (G)					
X AXIS		4.43	507	-13.18	394
Y AXIS		0.71	498	-1.69	451
Z AXIS		8.94	502	-13.49	388
RESULTANT		17.69	389	0.62	607
HEAD SEVERITY INDEX		42.63			
NEGATIVE G STRAP		259.93	529	20.81	306
SHOULDER STRAP LOADS (LB)					
X AXIS	43.92	692.17	368	-7.55	502
Y AXIS	-1.18	42.81	367	-9.56	400
Z AXIS	13.92	238.92	368	-6.81	513
RESULTANT	46.13	733.49	368	0.75	491
LEFT LAP LOADS (LB)					
X AXIS	27.97	941.20	360	6.27	818
Y AXIS	6.36	277.86	361	2.23	799
Z AXIS	38.13	926.57	360	18.01	787
RESULTANT	48.57	1349.18	360	27.13	787
RIGHT LAP LOADS (LB)					
X AXIS	23.36	873.82	360	7.28	768
Y AXIS	8.86	307.45	360	2.97	756
Z AXIS	31.51	902.47	360	18.22	786
RESULTANT	40.31	1293.26	360	25.71	815
TOTAL LAP LOAD (LB)	88.88	2642.44	360	55.33	815
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-71.50	98.63	507	-73.29	266
SEAT LOADS (LB)					
Z AXIS (LEFT)	50.89	480.71	363	1.00	500
Z AXIS (RIGHT)	33.63	507.09	365	-13.41	613
Z AXIS (CENTER)	147.24	1176.34	367	125.93	290
Z AXIS (SUM)	231.77	2154.95	365	213.91	229

RESTRAINT CONFIGURATION STUDY

TEST NO: 2076      SUBJ ID: R-2

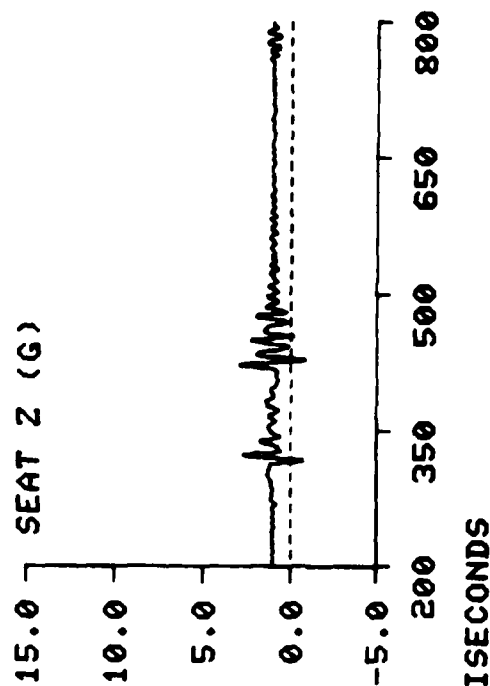
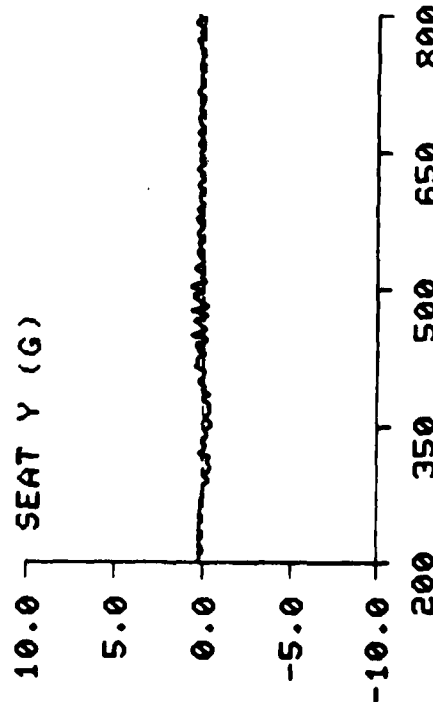
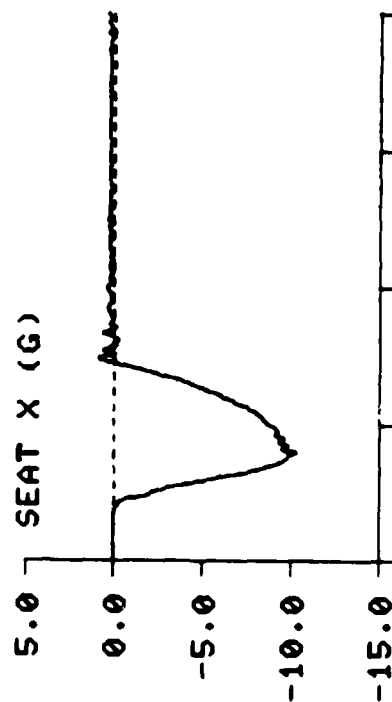




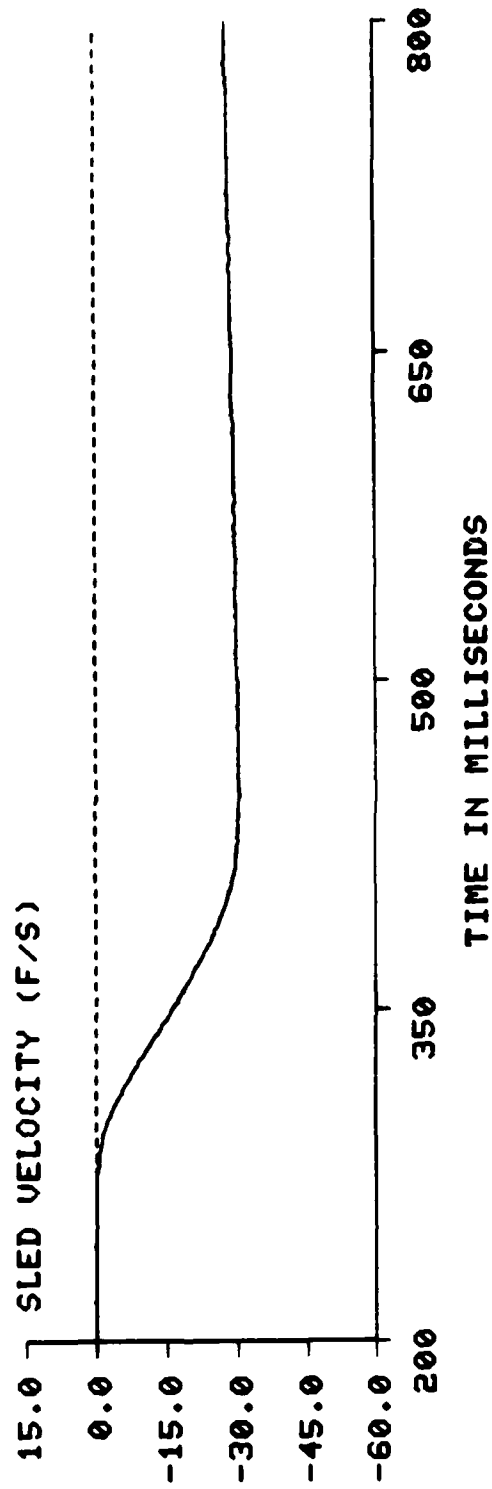
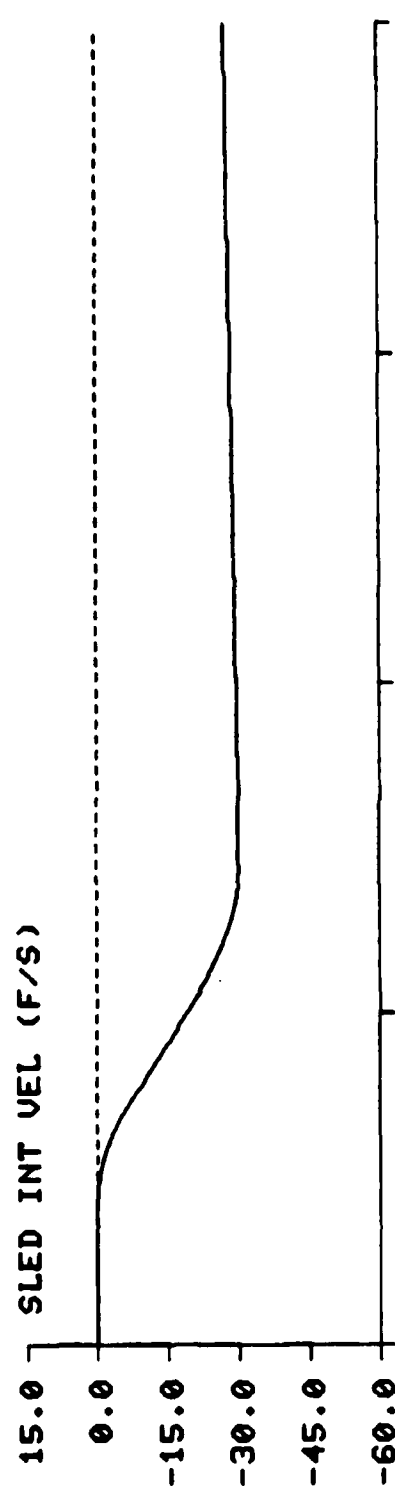
RESTRAINT CONFIGURATION STUDY

TEST NO: 2076

SUBJ ID: R-2



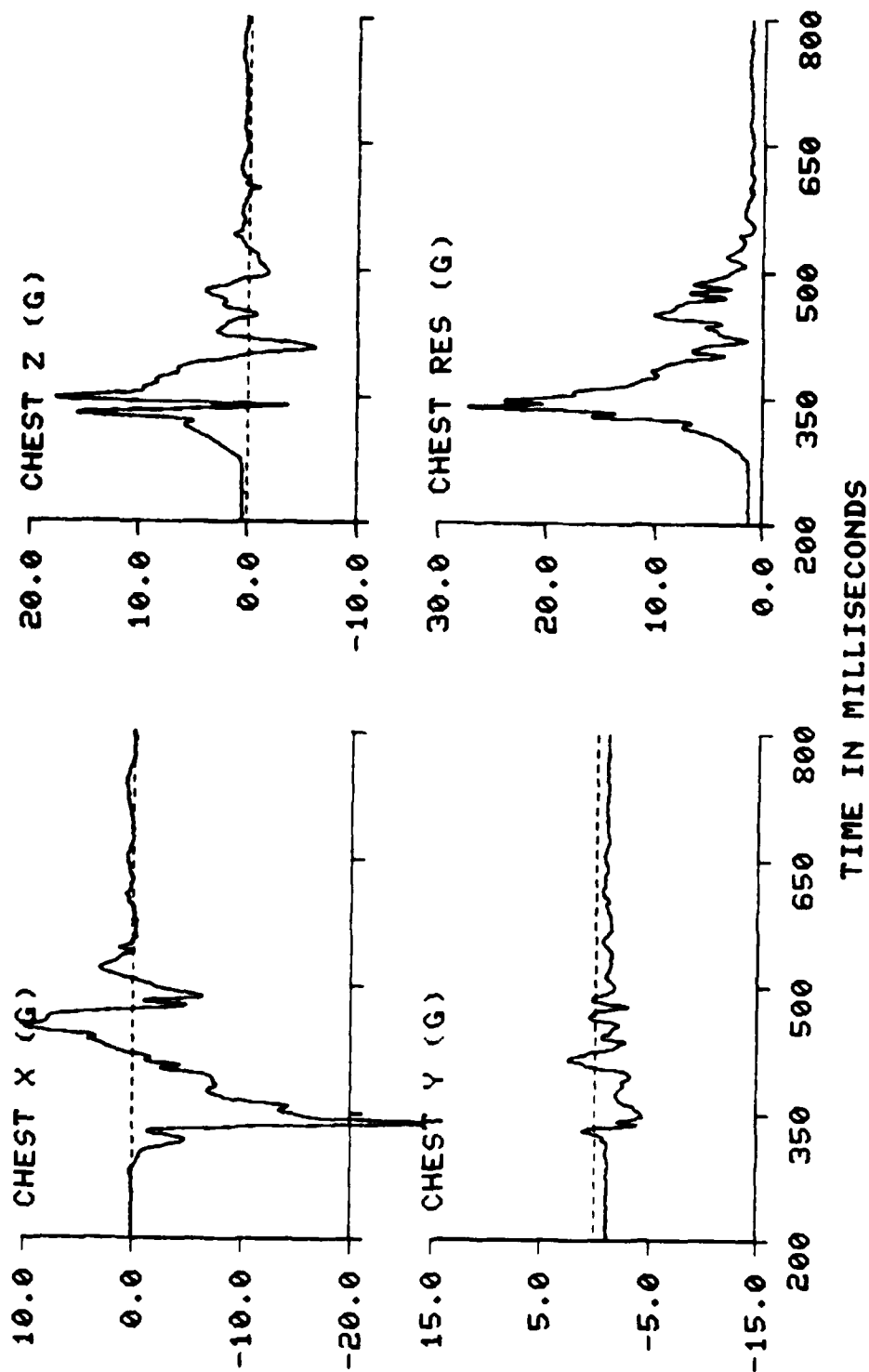
RESTRAINT CONFIGURATION STUDY      TEST NO: 2076      SUBJ ID: R-2



RESTRAINT CONFIGURATION STUDY

TEST NO: 2076

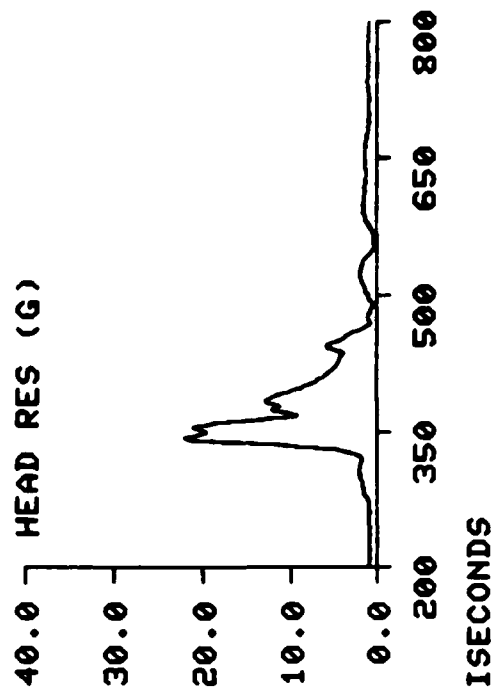
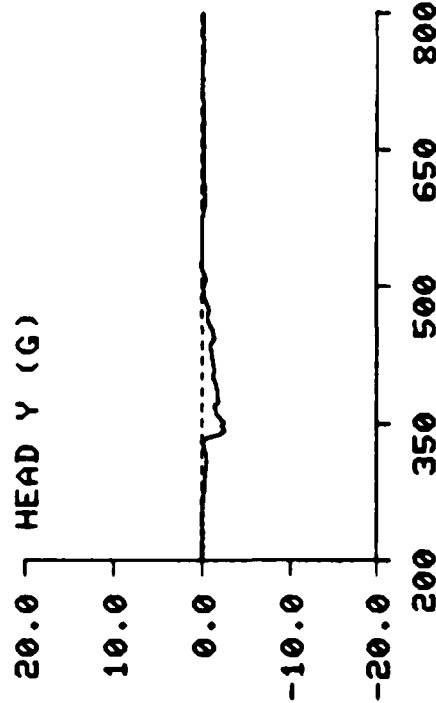
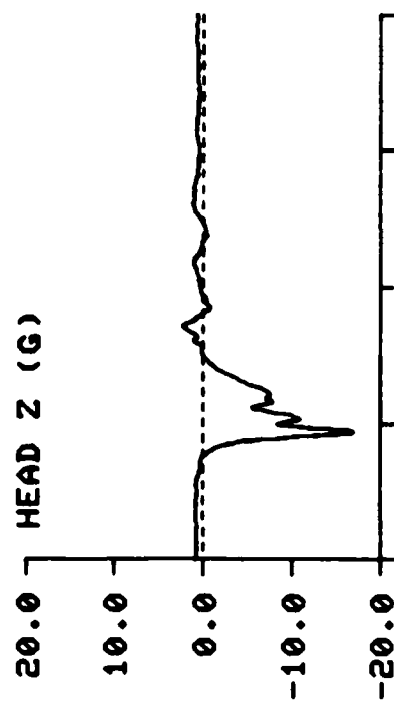
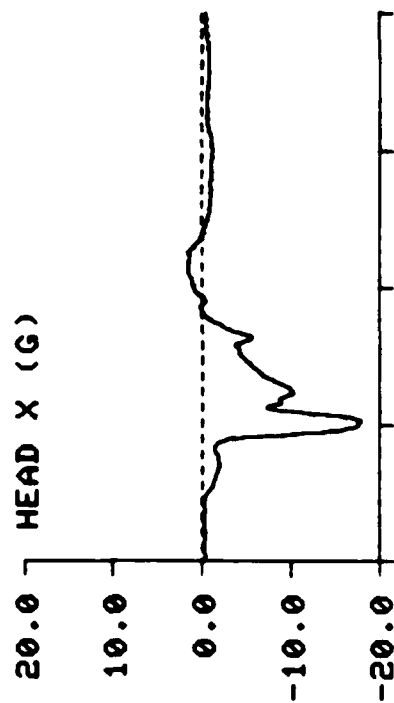
SUBJ ID: R-2



RESTRAINT CONFIGURATION STUDY

TEST NO: 2076

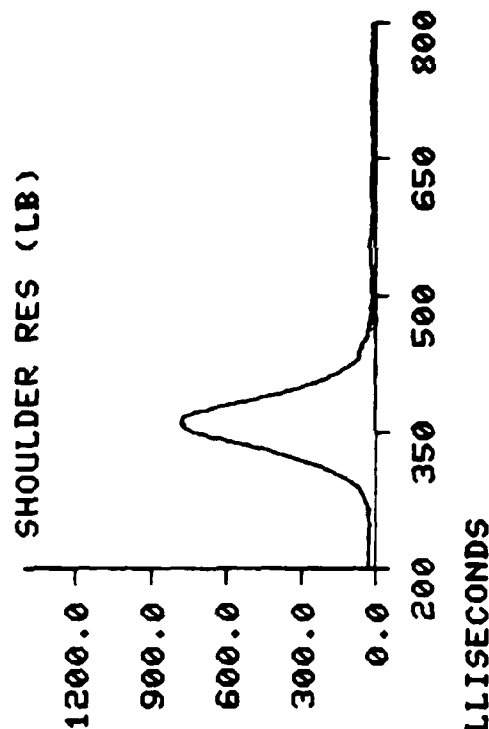
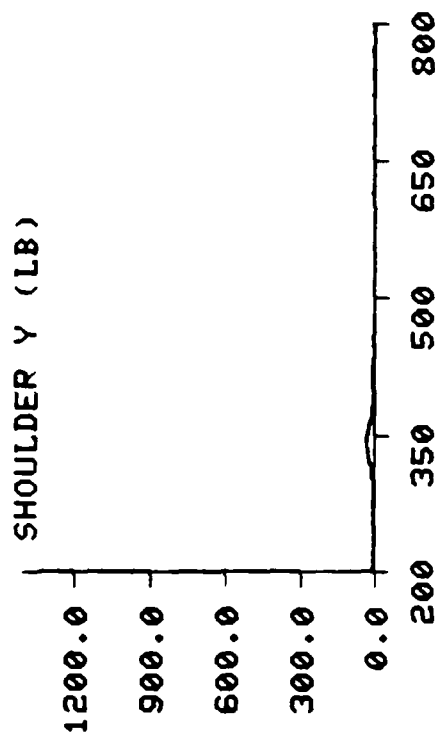
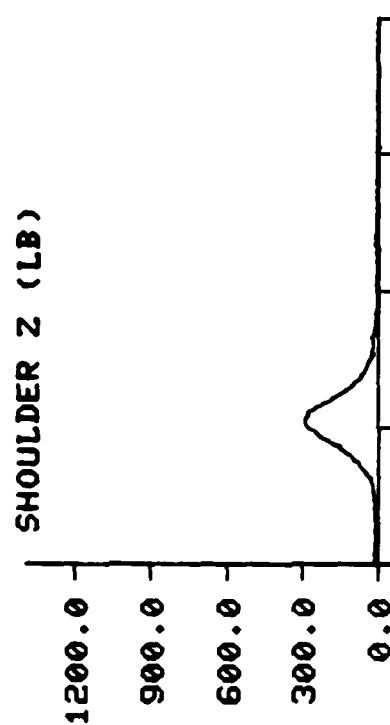
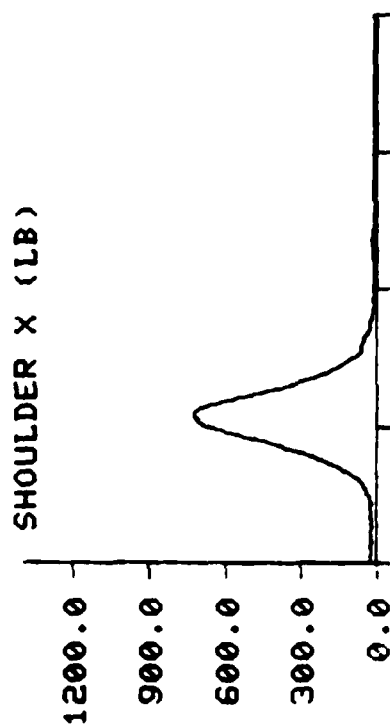
SUBJ ID: R-2



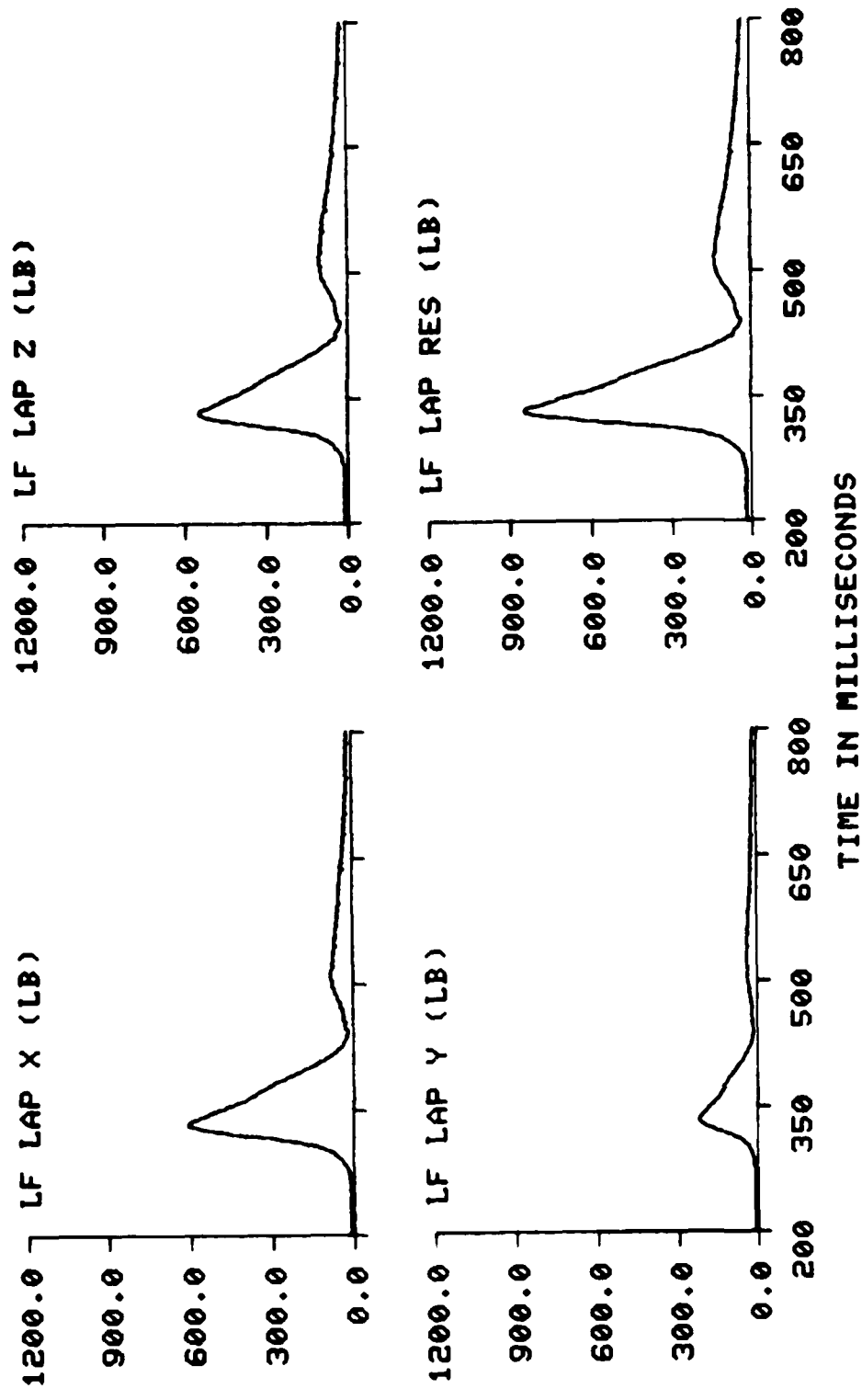
RESTRAINT CONFIGURATION STUDY

TEST NO: 2076

SUBJ ID: R-2



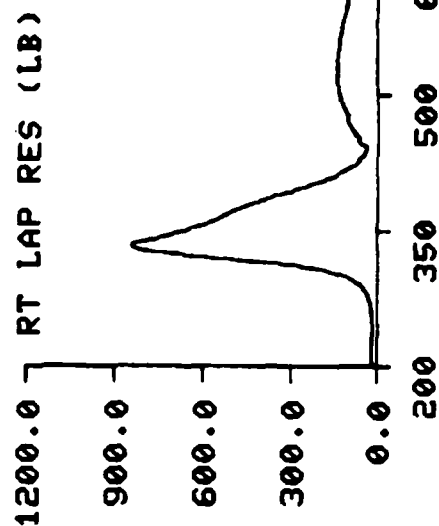
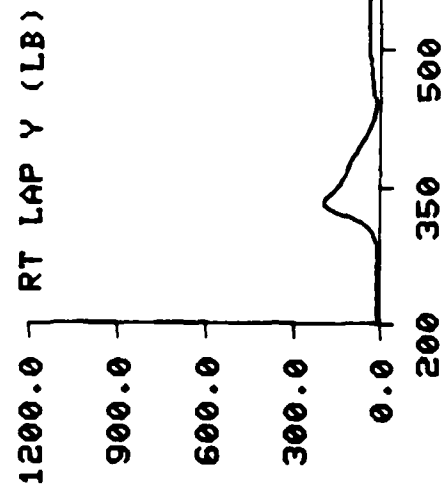
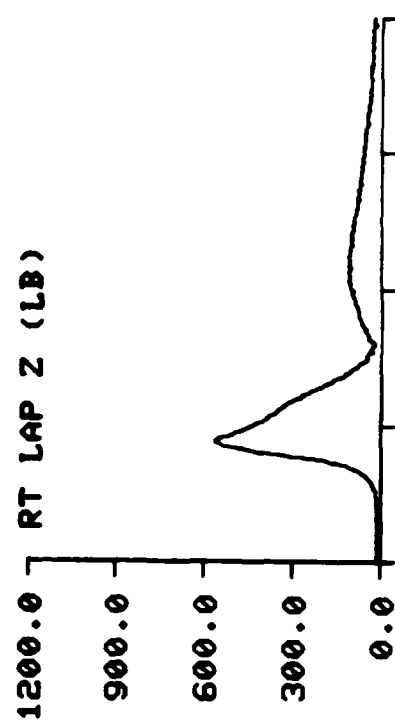
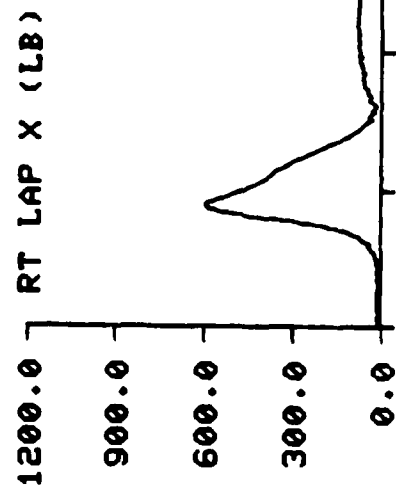
TIME IN MILLISECONDS



RESTRAINT CONFIGURATION STUDY

TEST NO: 2076

SUBJ ID: R-2



TIME IN MILLISECONDS

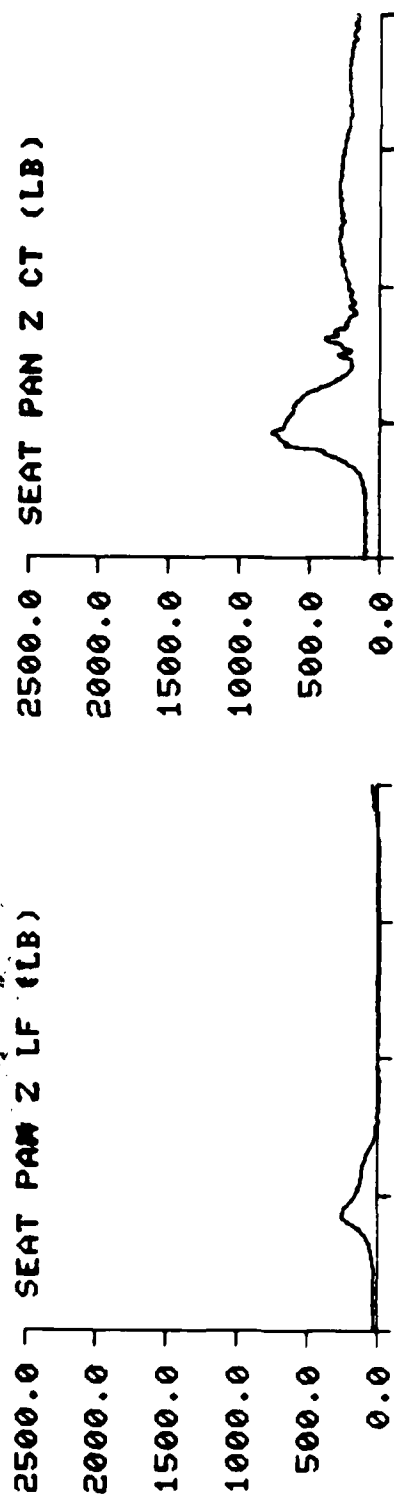
# RESTRAINT CONFIGURATION STUDY

TEST NO: 2076

SUBJ ID: R-2

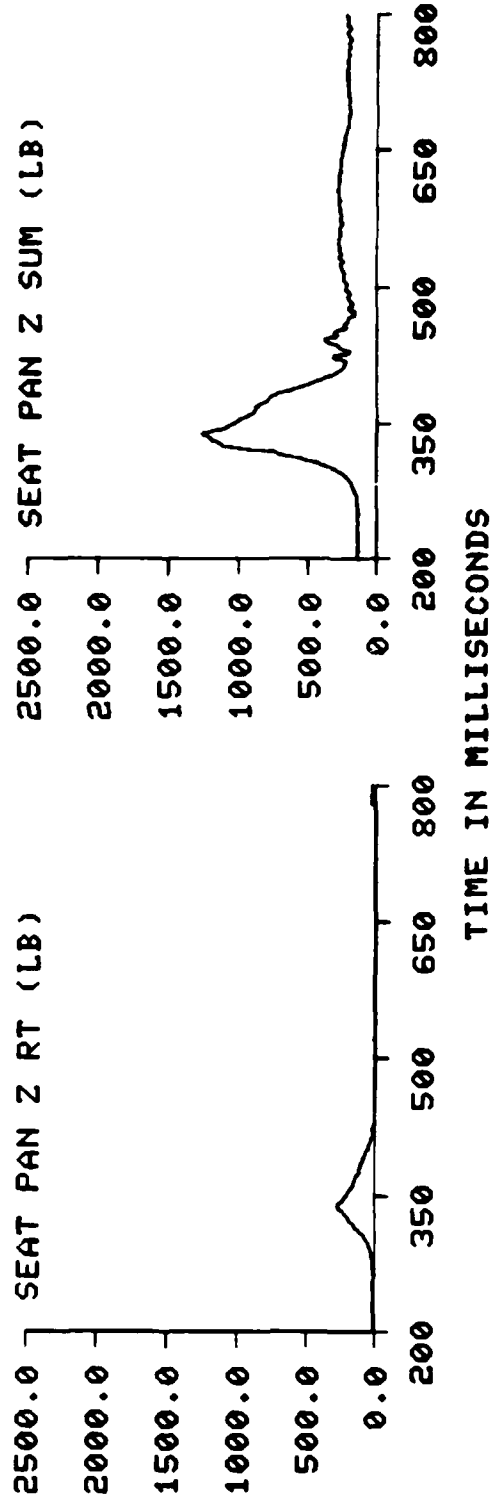
SEAT PAN Z LF (LB)

SEAT PAN Z CT (LB)



SEAT PAN Z RT (LB)

SEAT PAN Z SUM (LB)



TIME IN MILLISECONDS



HORIZONTAL TEST PHASE      TEST: 2137      SUBJ: B-2      WT: 186.0      CELL: C

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			216		
TIME OF IMPACT START			279		
SLED ACCELERATION (G)					
X AXIS		0.57	432	-9.58	329
X AXIS (SMOOTHED)		0.44	433	-9.53	328
Y AXIS		0.49	333	-0.41	525
Z AXIS		2.19	449	0.10	329
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	263	-30.11	428
TACHOMETER (MEASURED)		0.04	211	-30.35	449
SEAT ACCELERATION (G)					
X AXIS		0.74	435	-10.22	330
X AXIS (SMOOTHED)		0.60	435	-10.00	329
Y AXIS		0.55	463	-0.75	386
Z AXIS		2.88	334	-1.04	329
CHEST ACCELERATION (G)					
X AXIS		5.17	457	-12.57	357
Y AXIS		2.20	400	-3.85	456
Z AXIS		9.26	388	-6.31	370
RESULTANT		14.94	335	0.60	493
CHEST SEVERITY INDEX		36.55			
HEAD ACCELERATION (G)					
X AXIS		2.09	524	-15.24	393
Y AXIS		0.76	575	-2.96	395
Z AXIS		3.40	453	-10.79	389
RESULTANT		18.46	391	0.68	589
HEAD SEVERITY INDEX		65.11			
SHOULDER STRAP LOADS (LB)					
X AXIS	33.05	690.70	351	4.82	474
Y AXIS	0.88	31.86	341	-7.99	436
Z AXIS	11.19	238.83	351	-6.91	471
RESULTANT	35.01	731.43	351	7.19	487
LEFT LAP LOADS (LB)					
X AXIS	25.01	558.64	356	8.54	809
Y AXIS	9.57	216.38	358	5.25	779
Z AXIS	37.70	646.43	356	28.77	215
RESULTANT	46.33	880.77	356	36.84	809
RIGHT LAP LOADS (LB)					
X AXIS	21.70	526.75	355	9.34	800
Y AXIS	8.63	186.84	358	5.28	770
Z AXIS	35.21	663.25	356	29.30	230
RESULTANT	42.29	868.41	356	36.74	805
TOTAL LAP LOAD (LB)	88.62	1749.18	356	75.61	805
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-79.49	77.70	793	-89.23	529
SEAT LOADS (LB)					
Z AXIS (LEFT)	29.03	365.28	362	-7.83	531
Z AXIS (RIGHT)	18.18	329.69	363	-13.26	523
Z AXIS (CENTER)	169.55	912.34	354	85.03	509
Z AXIS (SUM)	216.78	1547.87	357	88.27	509

HORIZONTAL TEST PHASE      TEST: 2134      SUBJ: B-4      WT: 209.0      CELL: C

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			184		
TIME OF IMPACT START			254		
SLED ACCELERATION (G)					
X AXIS		0.58	407	-9.66	306
X AXIS (SMOOTHED)		0.41	408	-9.58	306
Y AXIS		0.48	305	-0.38	508
Z AXIS		1.88	423	0.05	302
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	206	-30.11	403
TACHOMETER (MEASURED)		0.21	189	-30.35	427
SEAT ACCELERATION (G)					
X AXIS		0.66	410	-10.29	303
X AXIS (SMOOTHED)		0.58	410	-10.01	303
Y AXIS		0.57	425	-0.76	430
Z AXIS		3.08	307	-1.23	302
CHEST ACCELERATION (G)					
X AXIS		3.28	428	-13.66	311
Y AXIS		0.82	319	-1.45	443
Z AXIS		8.76	310	-2.55	481
RESULTANT		16.09	310	0.67	570
CHEST SEVERITY INDEX		32.05			
HEAD ACCELERATION (G)					
X AXIS		1.90	460	-15.11	333
Y AXIS		1.59	325	-0.37	396
Z AXIS		2.33	455	-12.22	333
RESULTANT		19.45	333	0.36	771
HEAD SEVERITY INDEX		73.27			
SHOULDER STRAP LOADS (LB)					
X AXIS	32.73	845.59	331	-4.35	452
Y AXIS	1.71	20.74	340	-5.44	483
Z AXIS	10.36	265.93	330	-4.14	449
RESULTANT	34.53	886.61	331	1.76	464
LEFT LAP LOADS (LB)					
X AXIS	30.69	657.46	328	21.02	195
Y AXIS	11.45	227.83	327	7.32	190
Z AXIS	39.87	700.10	329	32.64	185
RESULTANT	51.72	985.66	328	46.51	185
RIGHT LAP LOADS (LB)					
X AXIS	30.84	634.95	326	19.59	180
Y AXIS	7.05	200.30	328	1.12	246
Z AXIS	41.03	741.62	328	31.76	241
RESULTANT	51.88	996.64	328	45.80	241
TOTAL LAP LOAD (LB)	103.59	1982.29	328	98.09	248
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	63.25	87.84	322	24.93	479
SEAT LOADS (LB)					
Z AXIS (LEFT)	8.62	331.78	343	-1.74	457
Z AXIS (RIGHT)	44.28	465.05	332	14.36	596
Z AXIS (CENTER)	124.19	836.99	327	108.82	217
Z AXIS (SUM)	177.09	1598.70	330	147.52	481

HORIZONTAL TEST PHASE

TEST: 2111

SUBJ: B-1

WT: 149.0

CELL: C

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			163		
TIME OF IMPACT START			221		
SLED ACCELERATION (G)					
X AXIS		0.49	378	-9.44	272
X AXIS (SMOOTHED)		0.34	379	-9.39	278
Y AXIS		0.49	288	-0.31	505
Z AXIS		1.96	396	0.06	389
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	197	-29.81	374
TACHOMETER (MEASURED)		0.22	213	-30.16	401
SEAT ACCELERATION (G)					
X AXIS		0.61	380	-10.12	276
X AXIS (SMOOTHED)		0.52	381	-9.87	276
Y AXIS		0.49	391	-0.69	403
Z AXIS		2.67	280	-1.04	275
CHEST ACCELERATION (G)					
X AXIS		3.45	426	-14.22	283
Y AXIS		0.73	322	-3.28	340
Z AXIS		7.72	405	-4.47	322
RESULTANT		15.77	283	0.49	469
CHEST SEVERITY INDEX		36.21			
HEAD ACCELERATION (G)					
X AXIS		1.95	485	-16.55	353
Y AXIS		1.82	425	-1.63	343
Z AXIS		4.86	383	-13.66	297
RESULTANT		19.90	351	0.38	442
HEAD SEVERITY INDEX		74.83			
SHOULDER STRAP LOADS (LB)					
X AXIS	31.59	530.01	349	12.14	416
Y AXIS	7.08	28.21	322	-3.67	362
Z AXIS	13.43	195.81	296	3.60	184
RESULTANT	35.10	558.58	349	16.76	420
LEFT LAP LOADS (LB)					
X AXIS	25.01	506.42	293	15.05	206
Y AXIS	16.66	256.77	295	12.81	226
Z AXIS	39.33	590.36	293	28.49	161
RESULTANT	49.59	819.24	293	41.22	161
RIGHT LAP LOADS (LB)					
X AXIS	26.07	490.23	293	20.55	175
Y AXIS	14.34	245.23	295	8.26	195
Z AXIS	40.42	609.29	293	32.79	215
RESULTANT	50.25	819.19	294	44.41	215
TOTAL LAP LOAD (LB)	99.83	1637.36	294	90.35	161
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-33.65	85.07	669	-165.95	387
SEAT LOADS (LB)					
Z AXIS (LEFT)	13.19	175.53	302	-16.36	427
Z AXIS (RIGHT)	51.78	307.99	298	10.56	509
Z AXIS (CENTER)	107.71	928.21	296	85.40	231
Z AXIS (SUM)	172.67	1390.38	297	181.67	231

HORIZONTAL TEST PHASE		TEST: 2151	SUBJ: B-3	WT: 180.0	CELL: C
PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			176		
TIME OF IMPACT START			241		
SLED ACCELERATION (G)					
X AXIS		0.61	396	-9.56	294
X AXIS (SMOOTHED)		0.47	396	-9.49	295
Y AXIS		0.45	288	-0.45	480
Z AXIS		2.11	412	0.00	290
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	215	-29.88	391
TACHOMETER (MEASURED)		0.22	177	-30.17	415
SEAT ACCELERATION (G)					
X AXIS		0.68	399	-10.20	291
X AXIS (SMOOTHED)		0.58	398	-9.94	291
Y AXIS		0.42	490	-0.67	346
Z AXIS		3.23	295	-1.41	290
CHEST ACCELERATION (G)					
X AXIS		7.11	427	-10.88	297
Y AXIS		2.33	409	-3.95	423
Z AXIS		9.77	320	-2.23	439
RESULTANT		13.79	297	0.13	531
CHEST SEVERITY INDEX		32.19			
HEAD ACCELERATION (G)					
X AXIS		2.99	434	-10.98	360
Y AXIS		1.82	396	-1.42	356
Z AXIS		8.06	426	-5.42	456
RESULTANT		11.36	980	0.60	685
HEAD SEVERITY INDEX		32.84			
SHOULDER STRAP LOADS (LB)					
X AXIS	60.29	525.34	313	15.38	429
Y AXIS	7.10	23.54	302	-3.78	433
Z AXIS	22.48	240.48	311	6.91	428
RESULTANT	64.76	578.16	313	16.93	429
LEFT LAP LOADS (LB)					
X AXIS	70.75	622.83	315	38.19	713
Y AXIS	39.41	264.94	311	25.66	708
Z AXIS	111.46	702.89	312	73.28	745
RESULTANT	137.80	975.79	315	92.36	745
RIGHT LAP LOADS (LB)					
X AXIS	67.97	608.88	314	36.22	649
Y AXIS	34.56	260.58	316	20.81	700
Z AXIS	99.50	686.76	315	67.17	695
RESULTANT	125.39	953.40	315	82.33	719
TOTAL LAP LOAD (LB)	263.19	1929.19	315	178.25	745
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-34.23	66.00	727	-87.85	655
SEAT LOADS (LB)					
Z AXIS (LEFT)	80.70	418.25	312	-9.69	646
Z AXIS (RIGHT)	69.81	413.31	313	-7.04	416
Z AXIS (CENTER)	151.77	979.95	318	137.14	211
Z AXIS (SUM)	312.28	1796.01	313	264.00	458

HORIZONTAL TEST PHASE

TEST: 2097

SUBJ: C-2

WT: 185.0

CELL: C

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			235		
TIME OF IMPACT START			292		
SLED ACCELERATION (G)					
X AXIS		0.55	445	-9.62	339
X AXIS (SMOOTHED)		0.38	448	-9.52	339
Y AXIS		0.49	346	-0.58	545
Z AXIS		2.10	461	0.03	342
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	249	-30.11	441
TACHOMETER (MEASURED)		0.21	285	-30.41	463
SEAT ACCELERATION (G)					
X AXIS		0.75	447	-10.23	343
X AXIS (SMOOTHED)		0.57	447	-9.99	343
Y AXIS		0.55	577	-0.64	410
Z AXIS		2.80	347	-1.13	342
CHEST ACCELERATION (G)					
X AXIS		2.28	476	-13.83	344
Y AXIS		3.59	398	-2.84	389
Z AXIS		18.59	402	-11.67	383
RESULTANT		18.66	402	0.52	573
CHEST SEVERITY INDEX		49.58			
HEAD ACCELERATION (G)					
X AXIS		2.50	518	-18.43	372
Y AXIS		1.64	599	-2.24	569
Z AXIS		6.65	436	-11.99	366
RESULTANT		20.93	370	0.75	255
HEAD SEVERITY INDEX		97.25			
SHOULDER STRAP LOADS (LB)					
X AXIS	19.37	671.18	359	-2.85	498
Y AXIS	0.82	36.80	412	-8.74	532
Z AXIS	9.05	267.83	359	-2.24	489
RESULTANT	21.53	723.08	358	1.18	495
LEFT LAP LOADS (LB)					
X AXIS	10.48	645.62	362	1.78	284
Y AXIS	5.23	249.24	362	-0.59	261
Z AXIS	15.82	742.34	364	7.13	238
RESULTANT	19.87	1014.61	364	14.64	238
RIGHT LAP LOADS (LB)					
X AXIS	12.51	612.50	361	4.67	246
Y AXIS	3.76	240.39	363	0.61	254
Z AXIS	16.21	749.62	363	8.99	287
RESULTANT	21.01	997.43	363	17.04	262
TOTAL LAP LOAD (LB)	40.88	2010.59	363	34.58	238
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	7.80	38.47	362	4.83	491
SEAT LOADS (LB)					
Z AXIS (LEFT)	20.28	312.56	364	-14.86	509
Z AXIS (RIGHT)	35.84	324.47	365	4.28	529
Z AXIS (CENTER)	115.14	988.94	363	43.88	519
Z AXIS (SUM)	171.27	1619.89	363	50.04	529

HORIZONTAL TEST PHASE      TEST: 2146      SUBJ: E-2      WT: 174.0      CELL: C

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			173		
TIME OF IMPACT START			239		
SLED ACCELERATION (G)					
X AXIS		0.59	391	-9.58	292
X AXIS (SMOOTHED)		0.46	394	-9.53	290
Y AXIS		0.47	292	-0.52	476
Z AXIS		2.33	411	0.14	269
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	224	-30.09	388
TACHOMETER (MEASURED)		0.06	170	-30.62	420
SEAT ACCELERATION (G)					
X AXIS		0.75	397	-10.27	290
X AXIS (SMOOTHED)		0.52	396	-10.02	290
Y AXIS		0.67	408	-0.46	325
Z AXIS		3.19	398	-1.26	403
CHEST ACCELERATION (G)					
X AXIS		6.90	423	-13.75	296
Y AXIS		-0.09	427	-2.38	397
Z AXIS		8.44	355	-6.37	328
RESULTANT		15.63	296	0.43	548
CHEST SEVERITY INDEX		38.16			
HEAD ACCELERATION (G)					
X AXIS		1.70	501	-15.71	359
Y AXIS		1.47	507	-1.23	428
Z AXIS		9.48	429	-10.30	357
RESULTANT		18.77	359	0.34	728
HEAD SEVERITY INDEX		56.81			
SHOULDER STRAP LOADS (LB)					
X AXIS	35.03	625.24	305	6.56	430
Y AXIS	2.98	16.24	292	-8.81	626
Z AXIS	14.01	261.79	308	1.46	222
RESULTANT	38.08	677.94	308	9.12	430
LEFT LAP LOADS (LB)					
X AXIS	28.66	658.99	306	25.01	205
Y AXIS	16.68	309.01	307	14.61	172
Z AXIS	40.96	742.62	306	37.30	189
RESULTANT	52.75	1039.83	307	50.75	189
RIGHT LAP LOADS (LB)					
X AXIS	25.92	610.14	306	22.40	183
Y AXIS	15.02	301.99	307	11.47	727
Z AXIS	40.91	741.42	306	37.71	173
RESULTANT	50.74	1006.18	306	48.97	177
TOTAL LAP LOAD (LB)	103.49	2044.97	306	99.93	174
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	81.76	142.58	309	-32.45	694
SEAT LOADS (LB)					
Z AXIS (LEFT)	39.32	328.91	315	-15.26	715
Z AXIS (RIGHT)	45.07	292.60	311	-6.34	531
Z AXIS (CENTER)	112.91	1129.49	309	100.77	255
Z AXIS (SUM)	197.30	1741.89	309	188.43	457

HORIZONTAL TEST PHASE

TEST: 2100

SUBJ: F-2

WT: 153.0

CELL: C

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			171		
TIME OF IMPACT START			290		
SLED ACCELERATION (G)					
X AXIS		0.51	383	-9.59	284
X AXIS (SMOOTHED)		0.31	384	-8.50	284
Y AXIS		0.47	283	-0.41	495
Z AXIS		1.02	400	0.07	393
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	212	-30.11	380
TACHOMETER (MEASURED)		0.22	198	-30.40	403
SEAT ACCELERATION (G)					
X AXIS		0.61	384	-10.21	281
X AXIS (SMOOTHED)		0.45	386	-8.95	281
Y AXIS		0.66	395	-0.80	349
Z AXIS		2.82	285	-1.14	280
CHEST ACCELERATION (G)					
X AXIS		2.89	405	-12.67	289
Y AXIS		1.64	341	-1.44	317
Z AXIS		19.80	337	-4.34	313
RESULTANT		19.89	337	0.29	525
CHEST SEVERITY INDEX		49.85			
HEAD ACCELERATION (G)					
X AXIS		1.43	478	-15.13	350
Y AXIS		1.24	622	-1.38	343
Z AXIS		5.92	410	-13.83	344
RESULTANT		20.18	349	0.78	748
HEAD SEVERITY INDEX		62.76			
SHOULDER STRAP LOADS (LB)					
X AXIS	49.14	528.90	346	13.01	412
Y AXIS	2.94	22.98	300	-3.21	401
Z AXIS	18.39	236.30	347	0.29	518
RESULTANT	52.60	578.71	346	18.08	495
LEFT LAP LOADS (LB)					
X AXIS	39.17	525.63	299	29.80	222
Y AXIS	22.58	251.50	300	19.26	180
Z AXIS	57.50	613.23	303	48.37	182
RESULTANT	73.21	845.58	303	67.30	182
RIGHT LAP LOADS (LB)					
X AXIS	34.56	480.23	305	28.13	190
Y AXIS	15.89	223.08	301	11.21	217
Z AXIS	51.04	583.32	302	45.79	175
RESULTANT	63.73	785.94	305	58.83	200
TOTAL LAP LOAD (LB)	136.94	1629.38	305	129.73	182
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	1.77	50.48	745	0.02	213
SEAT LOADS (LB)					
Z AXIS (LEFT)	24.70	281.70	313	3.01	711
Z AXIS (RIGHT)	30.47	274.85	311	-13.48	681
Z AXIS (CENTER)	125.80	784.68	301	109.19	179
Z AXIS (SUM)	180.97	1313.41	313	165.58	179

HORIZONTAL TEST PHASE      TEST: 2052      SUBJ: G-3      WT: 164.0      CELL: C

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			5960		
TIME OF IMPACT START			6026		
SLED ACCELERATION (G)					
X AXIS		0.62	6182	-9.60	6075
X AXIS (SMOOTHED)		0.45	6337	-9.51	6077
Y AXIS		0.48	6087	-0.38	6328
Z AXIS		1.26	6069	0.45	6061
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION	0.01		6009	-29.78	6176
TACHOMETER (MEASURED)	0.13		6005	-30.08	6202
SEAT ACCELERATION (G)					
X AXIS		0.56	6181	-9.70	6073
X AXIS (SMOOTHED)		0.47	6327	-9.58	6074
Y AXIS		0.55	6405	-0.47	6062
Z AXIS		2.57	6068	-0.37	6062
CHEST ACCELERATION (G)					
X AXIS		2.15	6224	-10.03	6076
Y AXIS		3.67	6141	-2.47	6120
Z AXIS		15.11	6141	-3.15	6118
RESULTANT		15.62	6141	0.50	6499
CHEST SEVERITY INDEX		33.56			
HEAD ACCELERATION (G)					
X AXIS		2.51	6243	-14.98	6142
Y AXIS		1.64	6158	-1.30	6234
Z AXIS		2.06	6240	-10.67	6138
RESULTANT		18.25	6140	0.28	6219
HEAD SEVERITY INDEX		56.91			
SHOULDER STRAP LOADS (LB)					
X AXIS	43.88	608.24	6144	3.40	6230
Y AXIS	0.18	33.61	6146	-5.10	6256
Z AXIS	20.10	268.17	6142	-6.76	6227
RESULTANT	48.32	663.56	6142	7.39	6233
LEFT LAP LOADS (LB)					
X AXIS	33.84	585.43	6097	30.39	5998
Y AXIS	15.83	231.88	6099	11.38	6030
Z AXIS	45.07	560.31	6097	36.30	5960
RESULTANT	58.59	842.56	6098	51.53	5960
RIGHT LAP LOADS (LB)					
X AXIS	33.20	549.41	6096	32.00	5960
Y AXIS	17.23	225.59	6097	15.00	5975
Z AXIS	49.37	582.29	6097	40.66	5995
RESULTANT	57.31	831.75	6097	54.63	6013
TOTAL LAP LOAD (LB)	115.91	1674.31	6098	107.71	5960
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-6.55	74.85	6366	-14.23	6517
SEAT LOADS (LB)					
Z AXIS (LEFT)	33.69	288.92	6099	13.28	6234
Z AXIS (RIGHT)	24.16	316.25	6098	-11.53	6304
Z AXIS (CENTER)	130.02	713.29	6099	115.27	5987
Z AXIS (SUM)	187.88	1318.46	6099	174.75	5987



HORIZONTAL TEST PHASE

TEST: 2152

SUBJ: M-6

WT: 187.0

CELL: C

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			209		
TIME OF IMPACT START			273		
SLED ACCELERATION (G)					
X AXIS		0.58	427	-9.47	318
X AXIS (SMOOTHED)		0.48	429	-9.42	323
Y AXIS		0.50	328	-0.56	516
Z AXIS		2.27	445	0.11	324
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	258	-29.86	423
TACHOMETER (MEASURED)		0.23	226	-30.10	453
SEAT ACCELERATION (G)					
X AXIS		0.73	432	-10.12	325
X AXIS (SMOOTHED)		0.61	431	-9.91	324
Y AXIS		0.59	524	-0.58	518
Z AXIS		2.92	432	-1.12	324
CHEST ACCELERATION (G)					
X AXIS		5.51	457	-13.53	329
Y AXIS		2.56	393	-3.32	476
Z AXIS		7.74	331	-2.91	505
RESULTANT		15.46	330	0.12	616
CHEST SEVERITY INDEX		30.55			
HEAD ACCELERATION (G)					
X AXIS		4.77	532	-13.93	390
Y AXIS		2.49	652	-0.95	398
Z AXIS		5.97	449	-3.13	362
RESULTANT		14.01	390	0.34	261
HEAD SEVERITY INDEX		40.14			
SHOULDER STRAP LOADS (LB)					
X AXIS	35.10	742.89	346	1.66	490
Y AXIS	5.24	45.59	335	-14.76	418
Z AXIS	15.91	296.00	344	-0.83	494
RESULTANT	38.96	799.67	346	5.84	480
LEFT LAP LOADS (LB)					
X AXIS	27.53	603.58	340	21.41	245
Y AXIS	11.05	239.95	343	8.89	247
Z AXIS	42.32	732.34	340	36.98	249
RESULTANT	51.72	978.31	341	48.21	249
RIGHT LAP LOADS (LB)					
X AXIS	24.31	549.96	340	17.48	251
Y AXIS	16.09	301.69	342	12.43	746
Z AXIS	40.01	705.14	340	34.26	255
RESULTANT	49.56	943.36	340	45.42	255
TOTAL LAP LOAD (LB)	101.28	1921.39	340	95.69	255
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-68.04	61.47	675	-70.59	222
SEAT LOADS (LB)					
Z AXIS (LEFT)	57.23	378.44	340	0.76	509
Z AXIS (RIGHT)	32.99	292.72	342	-13.81	668
Z AXIS (CENTER)	116.63	1073.47	344	85.02	491
Z AXIS (SUM)	206.85	1740.07	344	91.71	491

HORIZONTAL TEST PHASE

TEST: 2099

SUBJ: J-3

WT: 168.0

CELL: C

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			187		
TIME OF IMPACT START			248		
SLED ACCELERATION (G)					
X AXIS		0.54	401	-9.46	300
X AXIS (SMOOTHED)		0.37	403	-9.42	301
Y AXIS		0.48	309	-0.35	496
Z AXIS		2.06	421	0.02	296
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	185	-30.05	397
TACHOMETER (MEASURED)		0.22	231	-30.40	422
SEAT ACCELERATION (G)					
X AXIS		0.69	407	-10.10	297
X AXIS (SMOOTHED)		0.47	406	-9.84	297
Y AXIS		0.63	417	-0.66	342
Z AXIS		9.25	406	-1.20	412
CHEST ACCELERATION (G)					
X AXIS		3.27	428	-12.44	303
Y AXIS		0.91	411	-2.52	424
Z AXIS		8.43	316	-3.30	442
RESULTANT		14.70	304	0.52	542
CHEST SEVERITY INDEX		29.32			
HEAD ACCELERATION (G)					
X AXIS		1.36	515	-13.70	372
Y AXIS		0.71	478	-1.99	452
Z AXIS		7.91	433	-11.09	365
RESULTANT		17.19	371	0.17	257
HEAD SEVERITY INDEX		50.69			
SHOULDER STRAP LOADS (LB)					
X AXIS	56.02	501.31	370	20.99	438
Y AXIS	1.41	28.60	364	-7.83	446
Z AXIS	18.34	199.27	315	4.62	416
RESULTANT	59.02	533.56	312	23.27	440
LEFT LAP LOADS (LB)					
X AXIS	48.99	611.53	313	41.69	230
Y AXIS	30.78	288.72	312	22.47	765
Z AXIS	70.65	659.14	312	61.41	773
RESULTANT	91.38	944.35	313	81.75	773
RIGHT LAP LOADS (LB)					
X AXIS	43.90	576.28	312	33.76	192
Y AXIS	17.68	200.83	313	11.80	225
Z AXIS	63.52	648.72	312	55.80	779
RESULTANT	79.25	690.09	312	70.99	775
TOTAL LAP LOAD (LB)	170.63	1833.51	313	154.96	779
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	9.78	135.90	521	4.47	741
SEAT LOADS (LB)					
Z AXIS (LEFT)	46.51	322.39	316	5.63	440
Z AXIS (RIGHT)	65.25	393.46	318	-13.23	527
Z AXIS (CENTER)	114.34	821.56	316	99.59	268
Z AXIS (SUM)	226.10	1529.62	318	179.63	440

## HORIZONTAL TEST PHASE

TEST: 2157

SUBJ: J-4

WT: 184.0

CELL: C

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			163		
TIME OF IMPACT START			233		
SLED ACCELERATION (G)					
X AXIS		0.67	387	-9.62	267
X AXIS (SMOOTHED)		0.50	388	-9.56	267
Y AXIS		0.48	284	-0.40	489
Z AXIS		2.11	404	-0.08	280
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION	0.01		222	-29.95	362
TACHOMETER (MEASURED)	0.18		166	-30.15	413
SEAT ACCELERATION (G)					
X AXIS		0.66	391	-10.22	281
X AXIS (SMOOTHED)		0.59	390	-9.95	262
Y AXIS		0.52	481	-0.59	411
Z AXIS		3.17	285	-1.34	280
CHEST ACCELERATION (G)					
X AXIS		6.64	413	-12.39	290
Y AXIS		1.72	297	-1.34	392
Z AXIS		9.20	309	-1.06	439
RESULTANT	13.75		288	0.27	520
CHEST SEVERITY INDEX	29.38				
HEAD ACCELERATION (G)					
X AXIS		0.40	230	-11.26	301
Y AXIS		0.73	242	-0.24	337
Z AXIS		5.24	399	-0.36	289
RESULTANT	11.27		302	0.63	170
HEAD SEVERITY INDEX	47.19				
SHOULDER STRAP LOADS (LB)					
X AXIS	94.52	628.44	300	23.60	410
Y AXIS	1.55	12.84	290	-11.07	525
Z AXIS	14.55	172.02	307	-0.73	435
RESULTANT	95.67	649.16	300	25.33	410
LEFT LAP LOADS (LB)					
X AXIS	66.06	669.25	306	27.67	411
Y AXIS	31.57	234.44	307	12.76	402
Z AXIS	102.29	708.07	308	38.61	408
RESULTANT	125.82	1000.47	308	52.87	408
RIGHT LAP LOADS (LB)					
X AXIS	61.94	629.88	306	22.05	416
Y AXIS	25.30	207.88	307	7.43	751
Z AXIS	98.11	690.78	306	36.31	758
RESULTANT	118.78	957.68	307	45.54	758
TOTAL LAP LOAD (LB)	244.60	1955.57	307	103.44	416
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-52.21	106.15	669	-63.27	712
SEAT LOADS (LB)					
Z AXIS (LEFT)	76.45	387.12	306	-13.40	500
Z AXIS (RIGHT)	63.28	354.46	310	-15.81	717
Z AXIS (CENTER)	183.56	1050.66	309	102.50	450
Z AXIS (SUM)	323.29	1790.72	309	93.05	450

HORIZONTAL TEST PHASE

TEST: 2125

SUBJ: K-1

WT: 177.0

CELL: C

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			212		
TIME OF IMPACT START			286		
SLED ACCELERATION (G)					
X AXIS		0.57	439	-9.58	337
X AXIS (SMOOTHED)		0.44	440	-9.48	337
Y AXIS		0.48	331	-0.53	524
Z AXIS		2.16	458	-0.35	332
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	270	-29.96	435
TACHOMETER (MEASURED)		0.34	277	-30.28	462
SEAT ACCELERATION (G)					
X AXIS		0.66	444	-10.22	333
X AXIS (SMOOTHED)		0.51	443	-9.86	334
Y AXIS		0.66	455	-0.71	391
Z AXIS		3.72	338	-1.85	333
CHEST ACCELERATION (G)					
X AXIS		7.14	466	-13.91	346
Y AXIS		0.13	499	-2.29	369
Z AXIS		10.58	392	-1.46	513
RESULTANT		15.91	342	0.57	596
CHEST SEVERITY INDEX		36.48			
HEAD ACCELERATION (G)					
X AXIS		1.70	548	-12.71	407
Y AXIS		0.84	498	-1.65	404
Z AXIS		5.08	459	-6.74	402
RESULTANT		14.45	404	0.20	583
HEAD SEVERITY INDEX		37.43			
SHOULDER STRAP LOADS (LB)					
X AXIS	34.35	575.21	357	0.12	526
Y AXIS	4.17	21.38	343	-7.08	577
Z AXIS	13.67	228.27	358	-0.44	548
RESULTANT	37.26	619.20	358	7.31	526
LEFT LAP LOADS (LB)					
X AXIS	48.00	637.97	355	18.80	755
Y AXIS	25.92	272.94	354	11.38	757
Z AXIS	72.52	721.50	354	30.13	796
RESULTANT	90.78	999.28	355	41.14	796
RIGHT LAP LOADS (LB)					
X AXIS	51.34	641.08	355	18.18	773
Y AXIS	22.33	254.09	356	9.24	781
Z AXIS	74.15	742.56	354	36.81	758
RESULTANT	92.94	1010.93	355	47.00	773
TOTAL LAP LOAD (LB)	183.72	2010.21	355	93.23	796
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	59.88	91.60	353	26.82	808
SEAT LOADS (LB)					
Z AXIS (LEFT)	68.68	346.82	354	-3.44	506
Z AXIS (RIGHT)	90.23	451.88	354	-3.37	680
Z AXIS (CENTER)	85.58	925.54	354	64.14	299
Z AXIS (SUM)	244.50	1724.25	354	202.53	503

## HORIZONTAL TEST PHASE

TEST: 2113

SUBJ: M13

WT: 174.0

CELL: C

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			210		
TIME OF IMPACT START			268		
SLED ACCELERATION (G)					
X AXIS		0.55	423	-9.40	321
X AXIS (SMOOTHED)		0.41	423	-9.34	321
Y AXIS		0.48	321	-0.23	539
Z AXIS		2.01	439	0.02	317
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	244	-29.71	417
TACHOMETER (MEASURED)		0.16	228	-29.99	445
SEAT ACCELERATION (G)					
X AXIS		0.64	427	-10.06	318
X AXIS (SMOOTHED)		0.53	425	-9.80	318
Y AXIS		0.68	452	-0.56	387
Z AXIS		2.92	322	-1.16	317
CHEST ACCELERATION (G)					
X AXIS		4.82	448	-13.13	328
Y AXIS		1.20	426	-3.09	375
Z AXIS		8.89	381	-2.49	486
RESULTANT		14.99	326	0.34	498
CHEST SEVERITY INDEX		33.16			
HEAD ACCELERATION (G)					
X AXIS		1.24	538	-9.93	413
Y AXIS		1.43	585	-2.86	398
Z AXIS		2.76	437	-12.42	400
RESULTANT		15.53	400	0.76	495
HEAD SEVERITY INDEX		52.31			
SHOULDER STRAP LOADS (LB)					
X AXIS	22.18	531.90	332	4.15	460
Y AXIS	1.23	30.92	336	-4.37	462
Z AXIS	8.66	197.27	395	-4.67	541
RESULTANT	24.04	567.19	333	6.53	483
LEFT LAP LOADS (LB)					
X AXIS	31.28	580.00	333	24.96	271
Y AXIS	12.24	201.97	334	9.62	210
Z AXIS	41.80	609.65	333	35.82	237
RESULTANT	53.67	865.10	333	50.03	237
RIGHT LAP LOADS (LB)					
X AXIS	30.64	556.99	335	19.49	264
Y AXIS	9.54	178.47	334	5.94	222
Z AXIS	38.12	594.85	332	32.70	230
RESULTANT	49.90	832.55	334	44.29	264
TOTAL LAP LOAD (LB)	103.57	1697.38	333	98.90	230
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	49.66	82.40	337	46.89	218
SEAT LOADS (LB)					
Z AXIS (LEFT)	34.33	274.64	358	-4.05	715
Z AXIS (RIGHT)	58.88	329.54	347	0.24	550
Z AXIS (CENTER)	90.73	646.11	337	79.08	234
Z AXIS (SUM)	183.93	1230.52	338	174.04	234

HORIZONTAL TEST PHASE      TEST: 2102      SUBJ: P-3      WT: 196.0      CELL: C

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			173		
TIME OF IMPACT START			231		
SLED ACCELERATION (G)					
X AXIS		0.60	381	-9.42	276
X AXIS (SMOOTHED)		0.47	382	-9.35	279
Y AXIS		0.48	285	-0.40	482
Z AXIS		2.04	401	0.02	281
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	203	-28.77	376
TACHOMETER (MEASURED)		0.17	173	-30.10	398
SEAT ACCELERATION (G)					
X AXIS		0.75	388	-10.08	282
X AXIS (SMOOTHED)		0.52	387	-9.82	282
Y AXIS		0.86	415	-0.67	420
Z AXIS		2.97	388	-1.10	281
CHEST ACCELERATION (G)					
X AXIS		3.11	407	-13.11	313
Y AXIS		4.81	362	-4.54	343
Z AXIS		22.47	348	-8.37	325
RESULTANT		22.56	349	0.47	563
CHEST SEVERITY INDEX		59.31			
HEAD ACCELERATION (G)					
X AXIS		3.25	484	-15.90	363
Y AXIS		2.39	544	-3.75	513
Z AXIS		2.18	383	-10.47	313
RESULTANT		18.44	363	0.49	235
HEAD SEVERITY INDEX		60.94			
SHOULDER STRAP LOADS (LB)					
X AXIS	31.94	752.69	361	3.56	464
Y AXIS	1.98	33.45	369	-14.37	517
Z AXIS	6.76	184.76	358	-7.45	712
RESULTANT	32.78	774.88	361	6.03	463
LEFT LAP LOADS (LB)					
X AXIS	29.06	664.12	297	17.81	179
Y AXIS	12.90	250.77	298	9.15	174
Z AXIS	43.00	723.14	297	37.74	176
RESULTANT	53.54	1013.05	297	48.80	176
RIGHT LAP LOADS (LB)					
X AXIS	28.48	660.42	297	24.97	171
Y AXIS	12.23	228.00	298	9.79	173
Z AXIS	42.26	755.33	297	39.31	174
RESULTANT	52.44	1028.63	297	49.56	178
TOTAL LAP LOAD (LB)	105.98	2041.69	297	99.97	176
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	40.80	124.09	593	35.64	749
SEAT LOADS (LB)					
Z AXIS (LEFT)	44.16	356.60	299	-4.33	421
Z AXIS (RIGHT)	59.30	448.69	299	-12.63	572
Z AXIS (CENTER)	132.93	922.20	301	119.67	243
Z AXIS (SUM)	236.40	1724.45	301	232.07	171

HORIZONTAL TEST PHASE      TEST: 2120      SUBJ: R-2      WT: 143.0      CELL: C

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			227		
TIME OF IMPACT START			287		
SLED ACCELERATION (G)					
X AXIS		0.45	439	-9.43	332
X AXIS (SMOOTHED)		0.32	458	-9.37	335
Y AXIS		0.52	341	-0.31	563
Z AXIS		1.67	343	-0.10	357
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	265	-29.85	435
TACHOMETER (MEASURED)		0.28	262	-30.16	460
SEAT ACCELERATION (G)					
X AXIS		0.58	441	-10.00	338
X AXIS (SMOOTHED)		0.49	442	-9.80	338
Y AXIS		0.82	447	-0.65	442
Z AXIS		3.06	343	-1.18	337
CHEST ACCELERATION (G)					
X AXIS		2.87	456	-14.00	340
Y AXIS		1.04	347	-3.10	393
Z AXIS		7.91	345	-5.36	388
RESULTANT		15.94	360	0.49	446
CHEST SEVERITY INDEX		38.15			
HEAD ACCELERATION (G)					
X AXIS		2.83	550	-20.90	412
Y AXIS		1.43	568	-2.92	410
Z AXIS		4.64	447	-15.07	400
RESULTANT		22.73	411	0.55	678
HEAD SEVERITY INDEX		96.62			
SHOULDER STRAP LOADS (LB)					
X AXIS	18.18	651.09	412	8.70	541
Y AXIS	0.18	24.36	348	-7.51	684
Z AXIS	11.05	278.78	409	-3.45	538
RESULTANT	21.37	708.27	412	13.40	538
LEFT LAP LOADS (LB)					
X AXIS	14.60	534.91	349	2.07	222
Y AXIS	8.40	258.88	351	3.19	263
Z AXIS	18.97	596.14	350	14.35	242
RESULTANT	25.52	841.74	351	20.06	222
RIGHT LAP LOADS (LB)					
X AXIS	11.86	471.49	350	4.32	221
Y AXIS	7.26	242.62	350	2.84	239
Z AXIS	18.18	573.26	351	9.07	249
RESULTANT	23.06	780.90	351	16.90	249
TOTAL LAP LOAD (LB)	48.59	1622.64	351	40.49	280
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	73.21	188.17	528	21.24	617
SEAT LOADS (LB)					
Z AXIS (LEFT)	12.30	210.34	346	-13.52	609
Z AXIS (RIGHT)	22.22	256.52	355	-12.08	674
Z AXIS (CENTER)	111.05	876.65	356	98.91	277
Z AXIS (SUM)	145.57	1338.94	358	135.61	277

HORIZONTAL TEST PHASE

TEST: 2149

SUBJ: R-3

WT: 149.0

CELL: C

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			172		
TIME OF IMPACT START			238		
SLED ACCELERATION (G)					
X AXIS		0.60	391	-9.67	290
X AXIS (SMOOTHED)		0.43	392	-9.56	290
Y AXIS		0.53	291	-0.35	494
Z AXIS		1.78	408	-0.13	286
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.05	229	-29.90	386
TACHOMETER (MEASURED)		0.22	220	-30.40	422
SEAT ACCELERATION (G)					
X AXIS		0.63	391	-10.29	289
X AXIS (SMOOTHED)		0.57	394	-9.97	269
Y AXIS		0.07	402	-1.04	344
Z AXIS		2.73	292	-0.99	267
CHEST ACCELERATION (G)					
X AXIS		5.96	410	-12.57	299
Y AXIS		0.19	424	-1.74	410
Z AXIS		8.06	294	-2.24	437
RESULTANT		14.34	294	0.58	430
CHEST SEVERITY INDEX		29.07			
HEAD ACCELERATION (G)					
X AXIS		2.55	472	-11.86	357
Y AXIS		0.70	293	-0.66	322
Z AXIS		5.22	405	-5.42	320
RESULTANT		12.77	357	0.45	433
HEAD SEVERITY INDEX		30.65			
SHOULDER STRAP LOADS (LB)					
X AXIS	66.69	572.11	305	4.82	451
Y AXIS	6.65	30.95	299	-4.35	400
Z AXIS	32.02	269.63	308	1.99	462
RESULTANT	74.36	632.13	306	9.70	455
LEFT LAP LOADS (LB)					
X AXIS	52.20	501.85	312	25.75	720
Y AXIS	35.33	271.08	310	31.81	722
Z AXIS	81.33	601.60	310	43.71	764
RESULTANT	102.93	827.52	310	62.89	764
RIGHT LAP LOADS (LB)					
X AXIS	47.12	468.78	312	24.21	746
Y AXIS	28.01	236.40	311	14.39	768
Z AXIS	72.09	567.60	309	38.28	750
RESULTANT	90.60	773.18	312	53.41	750
TOTAL LAP LOAD (LB)	193.53	1600.37	312	117.50	764
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	6.05	9.01	307	-55.77	604
SEAT LOADS (LB)					
Z AXIS (LEFT)	14.28	202.24	317	-10.97	403
Z AXIS (RIGHT)	22.13	225.14	316	-5.52	532
Z AXIS (CENTER)	179.10	884.33	308	165.46	187
Z AXIS (SUM)	215.51	1287.31	310	184.04	714



HORIZONTAL TEST PHASE

TEST: 2156

SUBJ: T-1

WT: 167.0

CELL: C

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			161		
TIME OF IMPACT START			230		
SLED ACCELERATION (G)					
X AXIS		0.55	383	-9.65	283
X AXIS (SMOOTHED)		0.35	384	-9.58	285
Y AXIS		0.47	282	-0.27	504
Z AXIS		1.90	401	0.07	278
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	198	-30.04	380
TACHOMETER (MEASURED)		0.10	163	-30.28	407
SEAT ACCELERATION (G)					
X AXIS		0.60	384	-10.28	280
X AXIS (SMOOTHED)		0.45	388	-9.98	280
Y AXIS		0.64	395	-0.64	407
Z AXIS		2.89	283	-1.09	278
CHEST ACCELERATION (G)					
X AXIS		2.77	396	-12.37	286
Y AXIS		1.30	295	-0.94	421
Z AXIS		7.71	285	-0.17	421
RESULTANT		14.54	285	0.31	639
CHEST SEVERITY INDEX		27.54			
HEAD ACCELERATION (G)					
X AXIS		1.41	540	-10.73	347
Y AXIS		2.67	340	-0.26	541
Z AXIS		0.99	287	-6.46	394
RESULTANT		10.98	347	0.29	419
HEAD SEVERITY INDEX		28.37			
SHOULDER STRAP LOADS (LB)					
X AXIS	80.13	622.43	300	33.40	759
Y AXIS	1.98	20.49	302	-6.83	716
Z AXIS	29.49	252.55	298	6.81	601
RESULTANT	85.48	671.05	300	36.33	756
LEFT LAP LOADS (LB)					
X AXIS	72.97	496.77	297	37.94	749
Y AXIS	35.77	208.61	297	20.95	745
Z AXIS	104.48	559.08	299	58.98	730
RESULTANT	132.39	774.87	299	75.14	760
RIGHT LAP LOADS (LB)					
X AXIS	60.53	456.67	301	29.69	754
Y AXIS	31.89	202.25	297	18.29	750
Z AXIS	84.87	562.31	299	59.66	735
RESULTANT	116.99	749.06	299	73.01	754
TOTAL LAP LOAD (LB)	249.39	1523.93	299	149.82	760
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	37.37	81.03	298	0.67	591
SEAT LOADS (LB)					
Z AXIS (LEFT)	57.08	238.06	304	-14.74	408
Z AXIS (RIGHT)	47.77	270.90	300	8.38	487
Z AXIS (CENTER)	153.26	796.64	299	136.65	163
Z AXIS (SUM)	258.10	1296.41	300	239.65	755

HORIZONTAL TEST PHASE

TEST: 2129

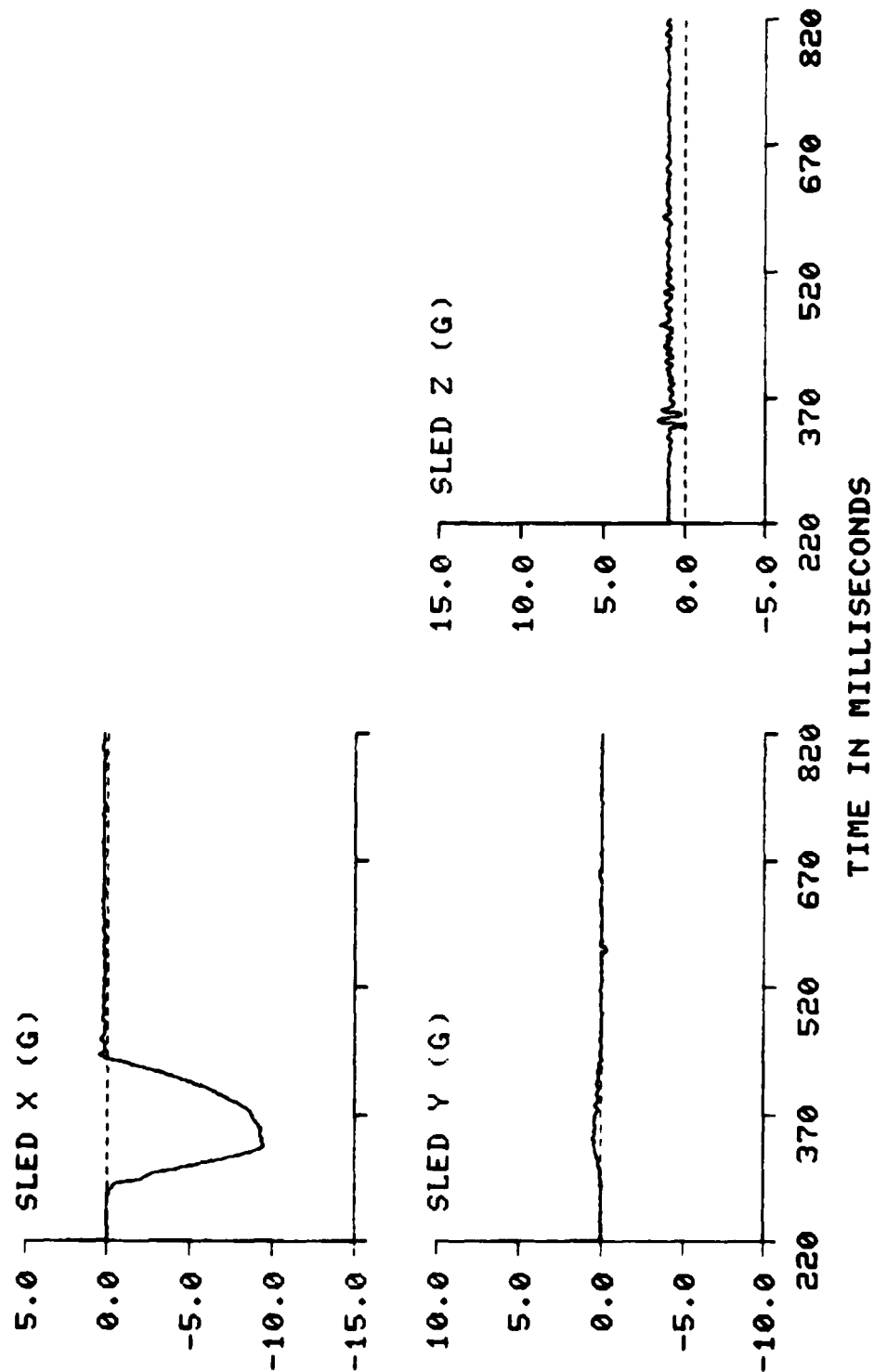
SUBJ: W-4

WT: 191.0

CELL: C

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			192		
TIME OF IMPACT START			259		
SLED ACCELERATION (G)					
X AXIS		0.62	413	-9.45	312
X AXIS (SMOOTHED)		0.48	415	-9.38	312
Y AXIS		0.49	312	-0.66	498
Z AXIS		2.30	434	0.09	425
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	207	-29.78	408
TACHOMETER (MEASURED)		0.28	221	-30.05	433
SEAT ACCELERATION (G)					
X AXIS		1.07	421	-10.05	310
X AXIS (SMOOTHED)		0.64	420	-9.86	309
Y AXIS		0.77	432	-0.41	356
Z AXIS		3.63	421	-1.40	426
CHEST ACCELERATION (G)					
X AXIS		7.21	450	-14.31	315
Y AXIS		0.81	355	-3.87	381
Z AXIS		11.90	381	-4.21	355
RESULTANT		16.64	316	0.61	469
CHEST SEVERITY INDEX		41.65			
HEAD ACCELERATION (G)					
X AXIS		1.57	554	-13.94	393
Y AXIS		0.93	487	-1.99	438
Z AXIS		5.70	439	-6.56	392
RESULTANT		15.45	393	0.26	597
HEAD SEVERITY INDEX		39.46			
SHOULDER STRAP LOADS (LB)					
X AXIS	53.37	637.10	386	-1.34	452
Y AXIS	7.22	31.31	327	-6.26	390
Z AXIS	22.33	239.75	386	-5.99	473
RESULTANT	58.35	680.73	388	3.84	476
LEFT LAP LOADS (LB)					
X AXIS	32.36	591.84	328	14.60	753
Y AXIS	20.34	335.10	330	16.07	440
Z AXIS	59.17	830.89	330	39.89	434
RESULTANT	70.48	1072.39	330	51.19	434
RIGHT LAP LOADS (LB)					
X AXIS	28.53	559.80	329	17.28	760
Y AXIS	17.53	321.86	331	13.57	439
Z AXIS	50.63	812.20	330	34.63	781
RESULTANT	60.74	1035.86	330	45.22	781
TOTAL LAP LOAD (LB)	131.22	2108.26	330	102.00	434
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-74.76	-4.52	328	-77.40	264
SEAT LOADS (LB)					
Z AXIS (LEFT)	39.90	346.30	330	12.79	466
Z AXIS (RIGHT)	27.89	375.70	332	-11.26	452
Z AXIS (CENTER)	169.37	1222.14	329	143.84	503
Z AXIS (SUM)	237.16	1942.63	330	177.27	503

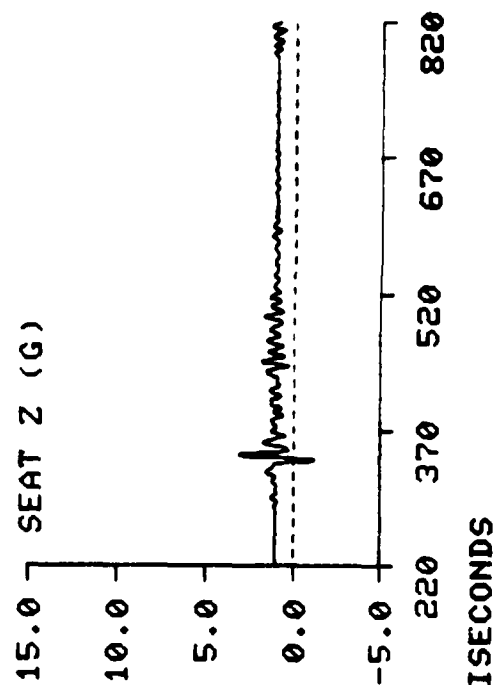
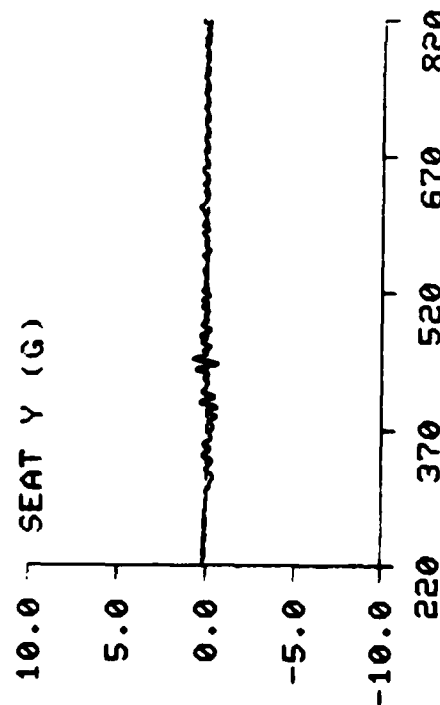
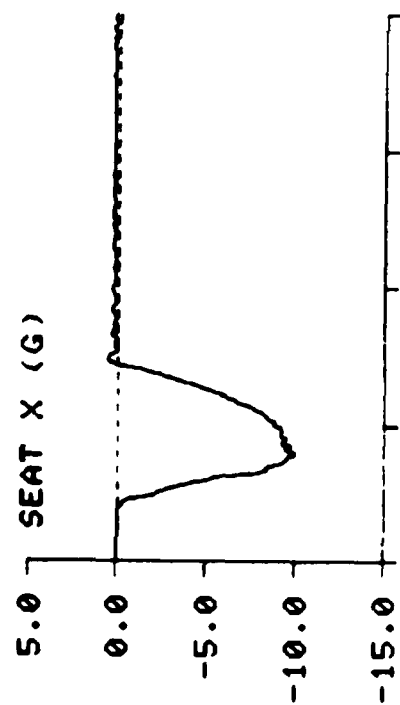
RESTRAINT CONFIGURATION STUDY      TEST NO: 2120      SUBJ ID: R-2

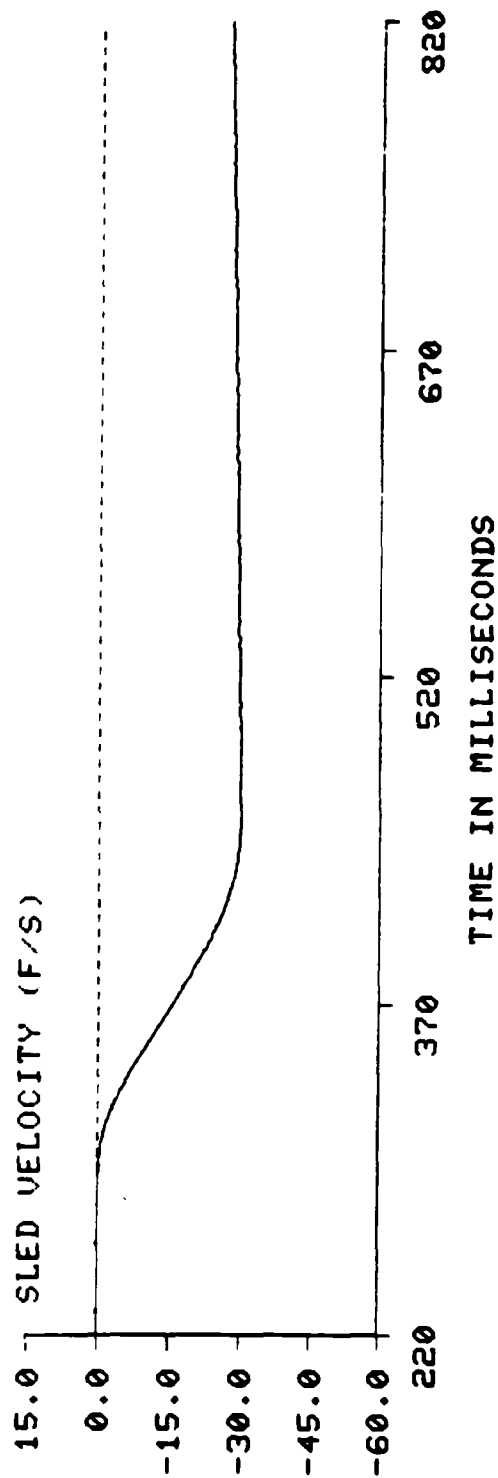
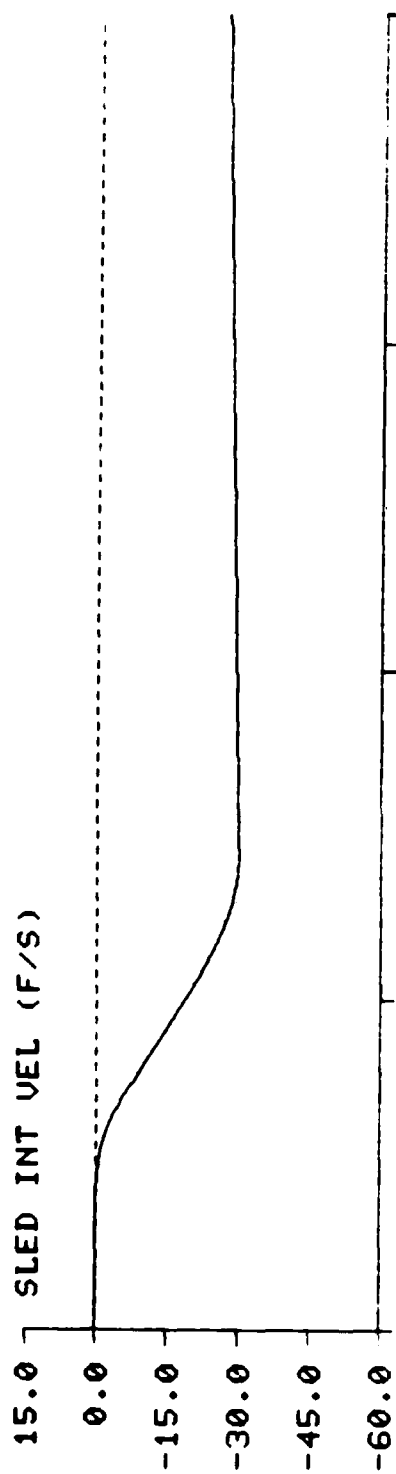


RESTRAINT CONFIGURATION STUDY

TEST NO: 2120

SUBJ ID: R-2

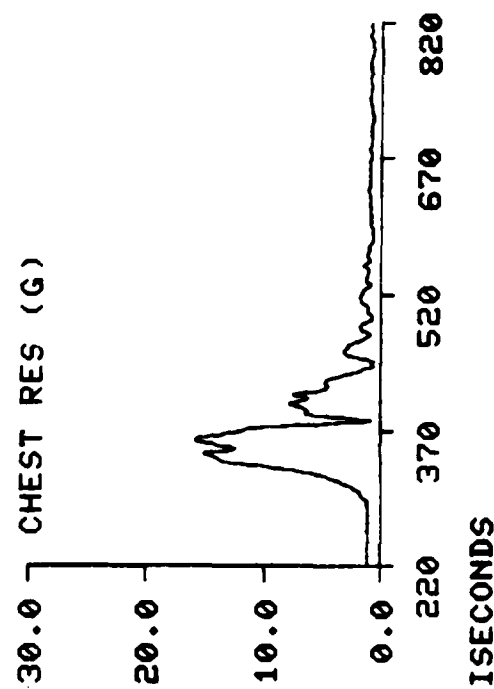
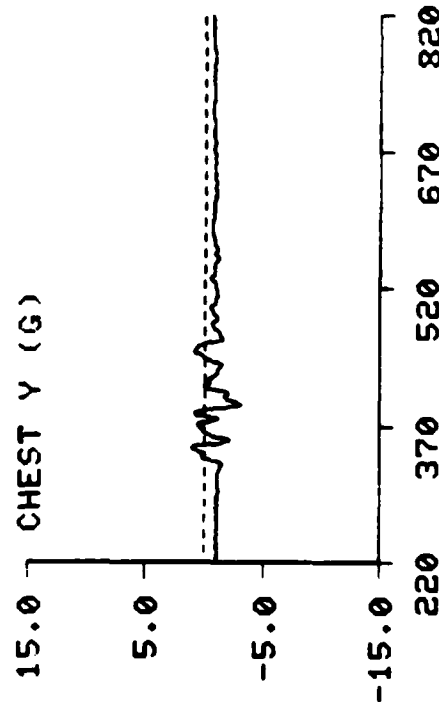
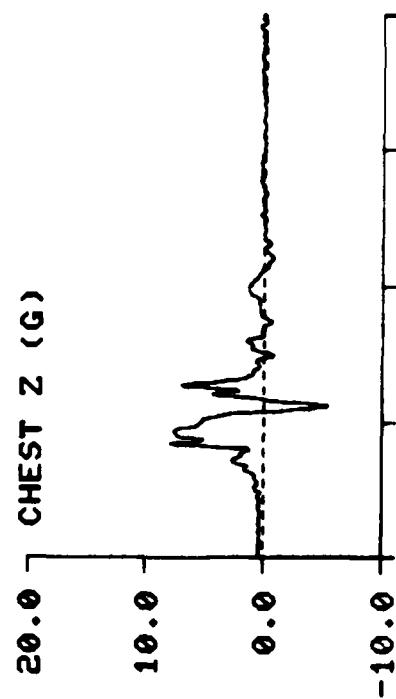
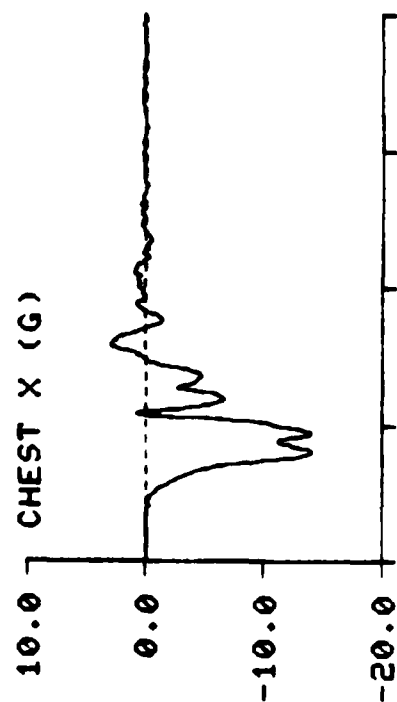




RESTRAINT CONFIGURATION STUDY

TEST NO: 2120

SUBJ ID: R-2

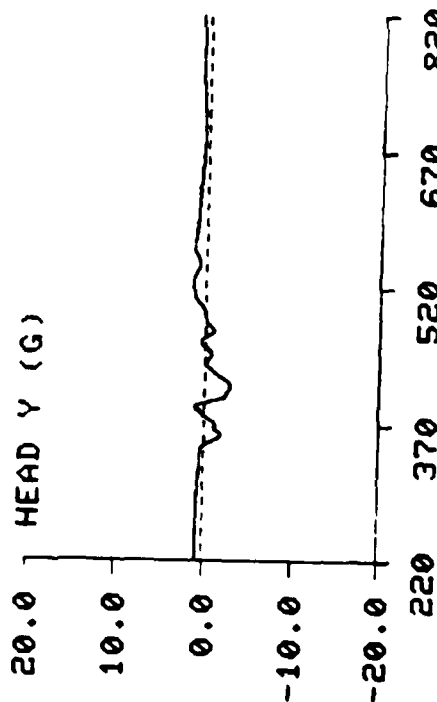
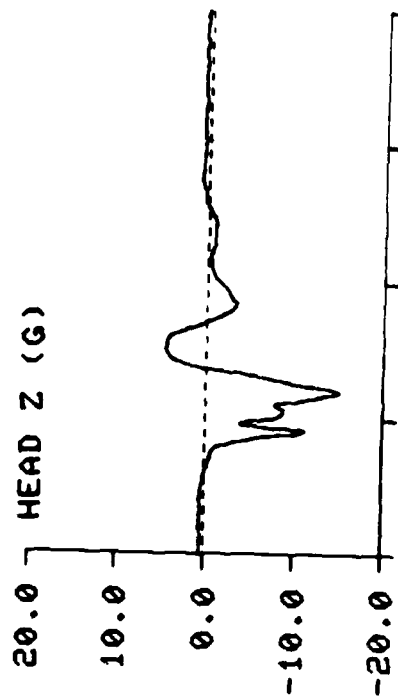
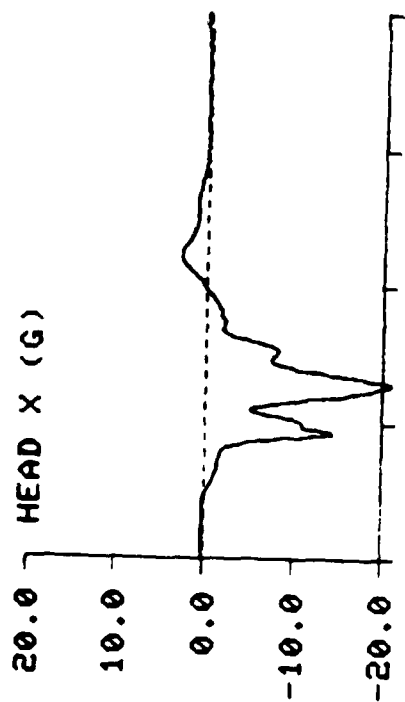


TIME IN MILLISECONDS

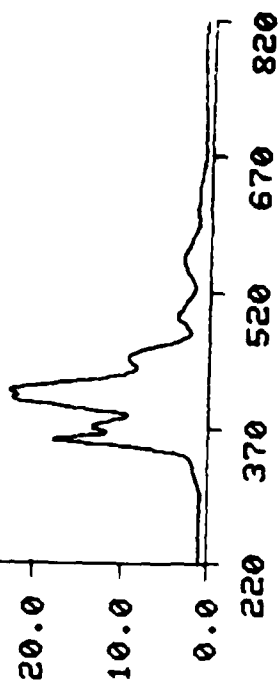
RESTRAINT CONFIGURATION STUDY

TEST NO: 2120

SUBJ ID: R-2



HEAD RES (G)



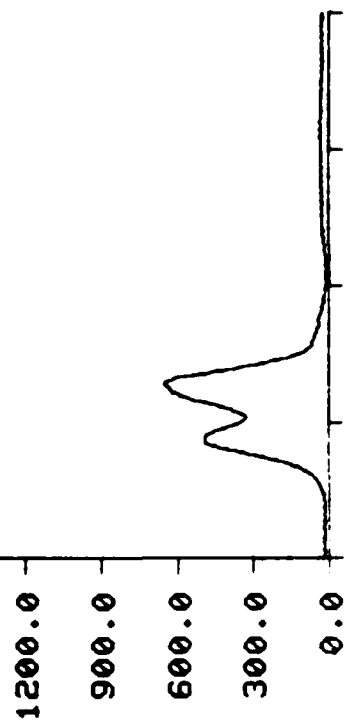
TIME IN MILLISECONDS

RESTRAINT CONFIGURATION STUDY

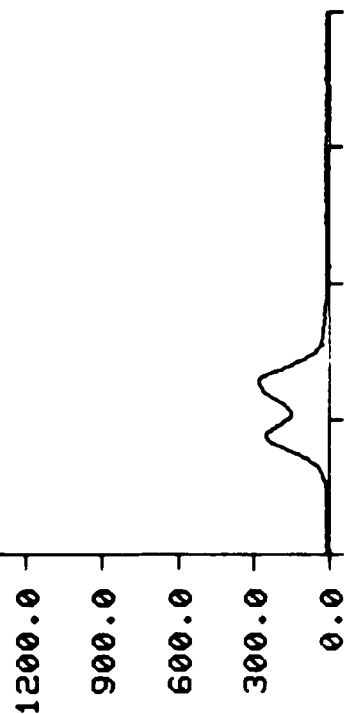
TEST NO: 2120

SUBJ ID: R-2

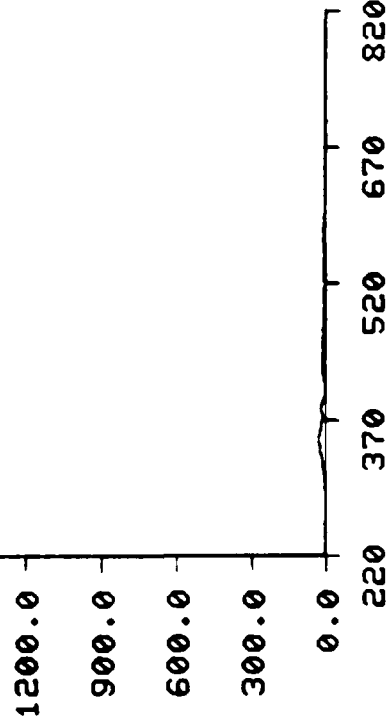
SHOULDER X (LB)



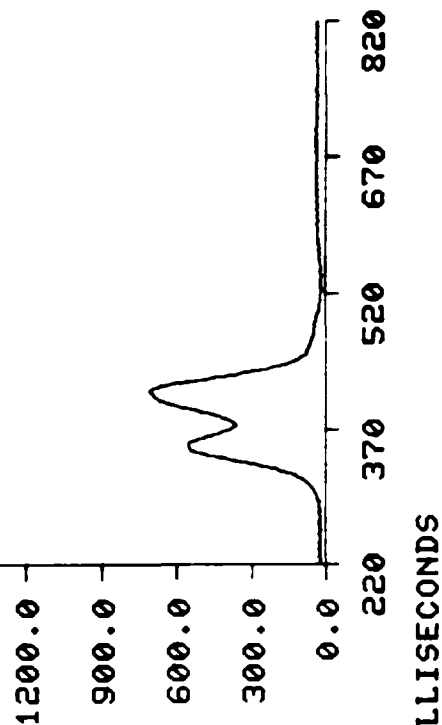
SHOULDER Z (LB)



SHOULDER Y (LB)



SHOULDER RES (LB)

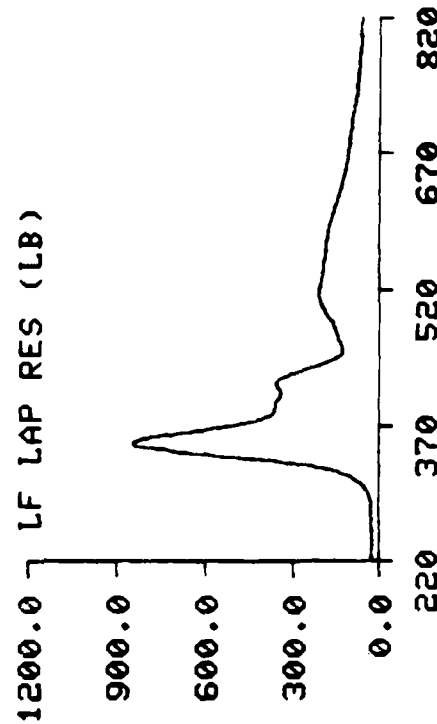
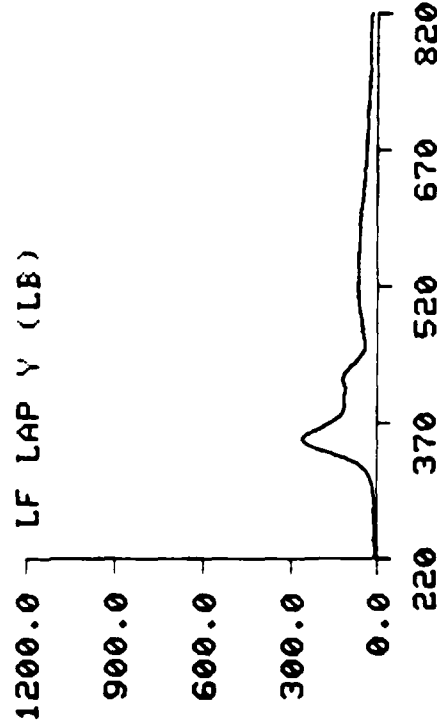
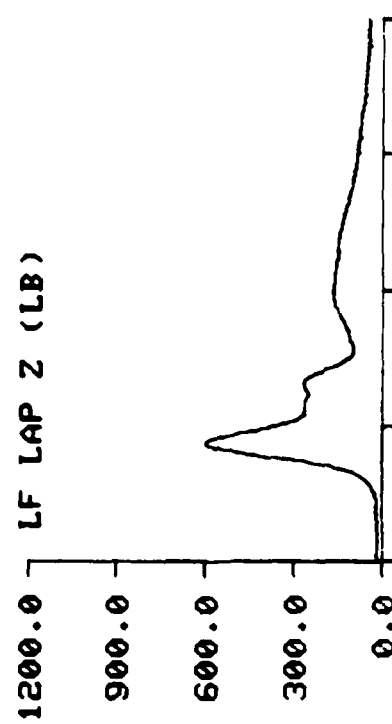
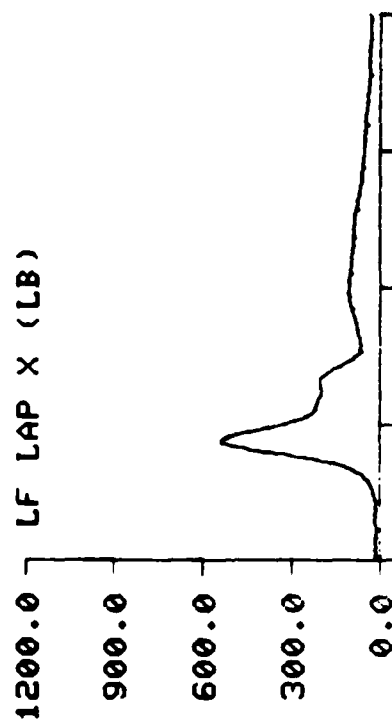




# RESTRAINT CONFIGURATION STUDY

TEST NO: 2120

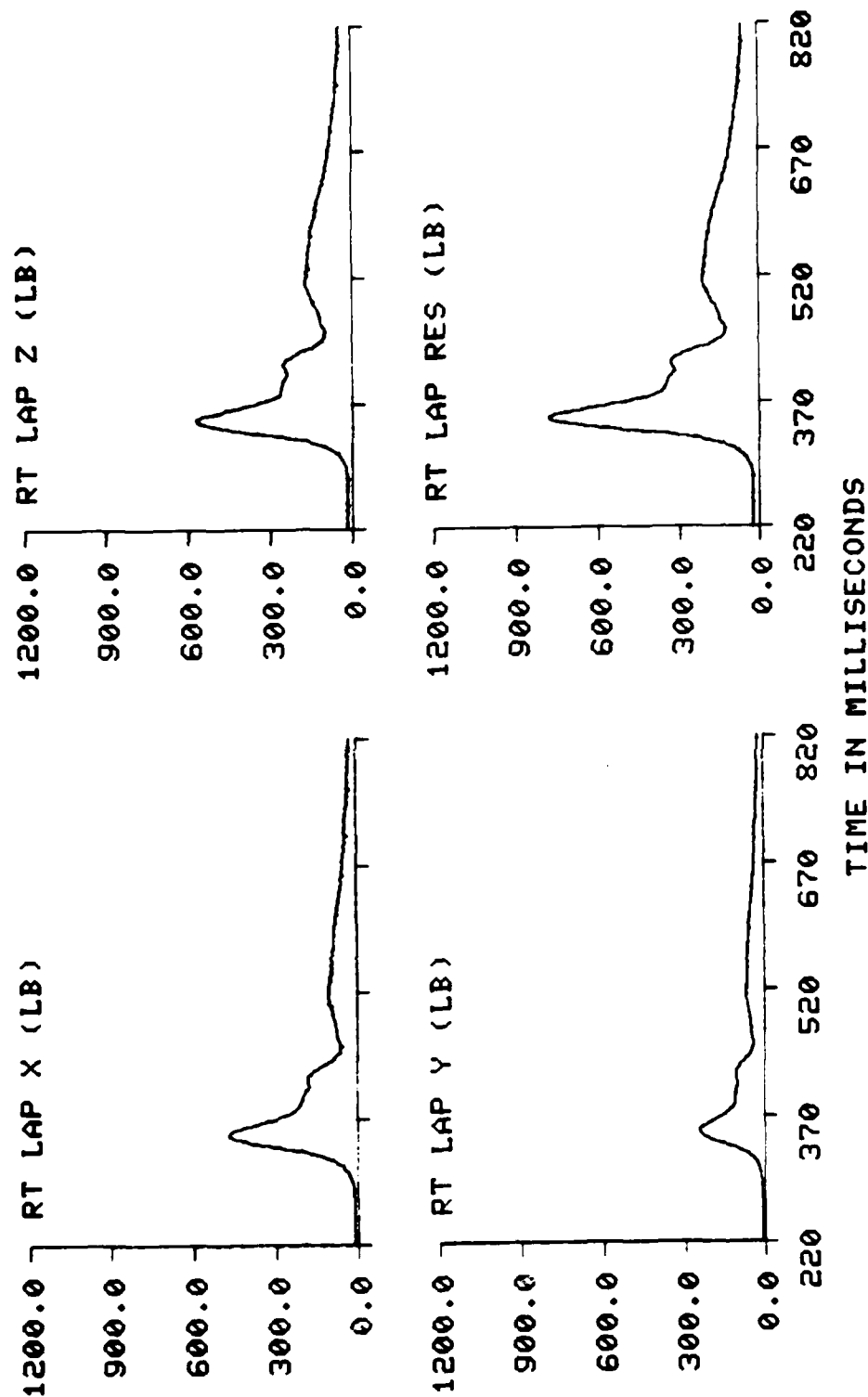
SUBJ ID: R-2



TIME IN MILLISECONDS

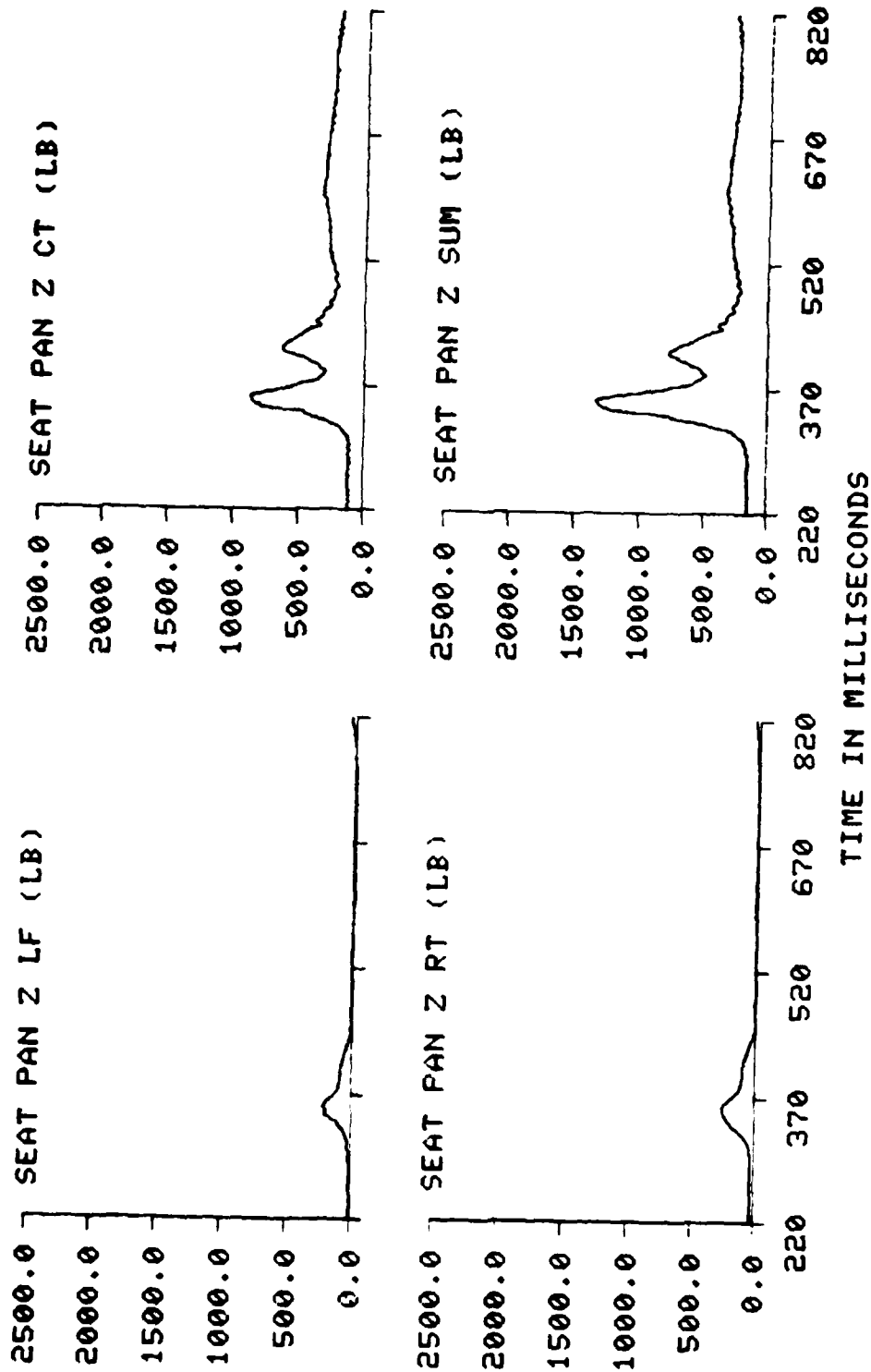
TEST NO: 2120 SUBJ ID: R-2

RESTRAINT CONFIGURATION STUDY



# RESTRAINT CONFIGURATION STUDY

TEST NO: 2120      SUBJ ID: R-2



HORIZONTAL TEST PHASE

TEST: 2145

SUBJ: B-2

WT: 185.0

CELL: 0

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			160		
TIME OF IMPACT START			225		
SLED ACCELERATION (G)					
X AXIS		0.57	379	-9.60	273
X AXIS (SMOOTHED)		0.47	360	-9.52	274
Y AXIS		0.48	280	-0.63	467
Z AXIS		2.41	397	0.15	290
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	160	-30.02	374
TACHOMETER (MEASURED)		0.17	199	-30.22	397
SEAT ACCELERATION (G)					
X AXIS		0.74	383	-10.26	278
X AXIS (SMOOTHED)		0.61	383	-10.00	277
Y AXIS		0.69	410	-0.54	332
Z AXIS		2.80	383	-0.99	277
CHEST ACCELERATION (G)					
X AXIS		6.62	413	-14.08	304
Y AXIS		2.09	301	-1.68	410
Z AXIS		10.34	283	-2.27	446
RESULTANT		16.58	284	0.62	531
CHEST SEVERITY INDEX		38.16			
HEAD ACCELERATION (G)					
X AXIS		1.62	469	-12.99	345
Y AXIS		0.39	493	-3.14	335
Z AXIS		4.37	414	-9.23	318
RESULTANT		15.39	337	0.26	510
HEAD SEVERITY INDEX		57.81			
NEGATIVE G STRAP		289.64	314	45.50	237
SHOULDER STRAP LOADS (LB)					
X AXIS	44.28	794.91	309	14.15	415
Y AXIS	2.25	28.17	286	-9.40	350
Z AXIS	15.96	247.29	305	1.56	427
RESULTANT	47.22	831.99	309	16.76	415
LEFT LAP LOADS (LB)					
X AXIS	23.29	601.81	294	7.30	725
Y AXIS	7.74	186.12	295	4.32	200
Z AXIS	31.00	607.85	293	20.08	744
RESULTANT	39.61	875.39	295	25.83	754
RIGHT LAP LOADS (LB)					
X AXIS	22.66	564.28	295	14.22	190
Y AXIS	6.44	179.59	295	1.98	228
Z AXIS	32.83	635.02	293	21.58	758
RESULTANT	40.48	866.39	296	28.20	758
TOTAL LAP LOAD (LB)	80.09	1741.26	294	55.55	758
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-59.00	9.09	723	-153.48	426
SEAT LOADS (LB)					
Z AXIS (LEFT)	35.82	492.93	303	-15.72	458
Z AXIS (RIGHT)	32.72	473.88	299	-13.23	563
Z AXIS (CENTER)	179.22	838.97	297	163.48	170
Z AXIS (SUM)	247.76	1778.39	298	233.35	170

## HORIZONTAL TEST PHASE

TEST: 2118

SUBJ: B-4

WT: 200.0

CELL: D

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			171		
TIME OF IMPACT START			242		
SLED ACCELERATION (G)					
X AXIS		0.63	396	-9.39	295
X AXIS (SMOOTHED)		0.45	397	-9.32	294
Y AXIS		0.47	295	-0.56	485
Z AXIS		1.93	412	0.14	292
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	170	-29.53	392
TACHOMETER (MEASURED)		0.16	188	-29.76	416
SEAT ACCELERATION (G)					
X AXIS		0.69	396	-10.09	293
X AXIS (SMOOTHED)		0.60	399	-9.80	293
Y AXIS		0.63	415	-0.68	420
Z AXIS		2.81	297	-0.95	292
CHEST ACCELERATION (G)					
X AXIS		5.60	447	-17.32	304
Y AXIS		2.19	324	-1.84	433
Z AXIS		9.41	300	-3.20	490
RESULTANT		18.58	303	0.79	697
CHEST SEVERITY INDEX		37.90			
HEAD ACCELERATION (G)					
X AXIS		2.32	453	-14.56	328
Y AXIS		1.58	340	-0.71	495
Z AXIS		4.18	444	-15.52	326
RESULTANT		20.97	326	0.51	653
HEAD SEVERITY INDEX		76.13			
NEGATIVE G STRAP		294.81	325	38.12	766
SHOULDER STRAP LOADS (LB)					
X AXIS	3.21	880.26	319	-3.28	432
Y AXIS	12.89	29.67	311	-5.62	765
Z AXIS	39.53	266.81	320	-8.13	450
RESULTANT	0.20	920.25	320	1.07	457
LEFT LAP LOADS (LB)					
X AXIS	14.92	667.28	313	28.37	730
Y AXIS	51.13	236.74	313	9.20	739
Z AXIS	67.38	691.34	312	33.83	741
RESULTANT	35.97	989.57	313	51.16	741
RIGHT LAP LOADS (LB)					
X AXIS	7.56	638.17	313	25.32	743
Y AXIS	45.55	174.26	314	1.73	752
Z AXIS	58.58	693.86	314	31.18	754
RESULTANT	125.96	957.01	314	44.50	754
TOTAL LAP LOAD (LB)	0.63	1946.58	314	101.54	754
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	48.79	-31.95	312	-77.43	245
SEAT LOADS (LB)					
Z AXIS (LEFT)	55.84	472.52	319	8.04	456
Z AXIS (RIGHT)	150.78	557.89	314	2.49	453
Z AXIS (CENTER)	255.41	907.33	312	132.68	181
Z AXIS (SUM)	1.28	1910.11	314	191.02	458

HORIZONTAL TEST PHASE

TEST: 2063

SUBJ: B-1

WT: 150.0

CELL: 0

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			166		
TIME OF IMPACT START			223		
SLED ACCELERATION (G)					
X AXIS		0.52	377	-9.62	271
X AXIS (SMOOTHED)		0.37	378	-9.52	272
Y AXIS		0.46	274	-0.48	467
Z AXIS		1.90	394	0.23	275
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	204	-29.96	373
TACHOMETER (MEASURED)		0.17	174	-30.28	397
SEAT ACCELERATION (G)					
X AXIS		0.69	379	-10.23	277
X AXIS (SMOOTHED)		0.57	380	-9.93	276
Y AXIS		0.57	434	-0.65	401
Z AXIS		2.41	281	-0.49	276
CHEST ACCELERATION (G)					
X AXIS		6.44	417	-19.56	291
Y AXIS		2.21	297	-3.21	407
Z AXIS		11.71	352	-6.82	334
RESULTANT		19.85	291	0.46	516
CHEST SEVERITY INDEX		52.36			
HEAD ACCELERATION (G)					
X AXIS		2.38	501	-23.45	306
Y AXIS		2.49	305	-0.92	391
Z AXIS		4.61	378	-17.94	298
RESULTANT		27.79	306	0.51	241
HEAD SEVERITY INDEX		98.68			
NEGATIVE G STRAP		323.91	358	42.74	229
SHOULDER STRAP LOADS (LB)					
X AXIS	31.47	675.05	307	-0.95	433
Y AXIS	2.50	32.02	294	-21.50	346
Z AXIS	11.92	221.45	304	-4.82	437
RESULTANT	33.86	710.89	307	5.71	426
LEFT LAP LOADS (LB)					
X AXIS	16.43	632.45	293	5.87	173
Y AXIS	5.32	221.84	295	0.16	208
Z AXIS	19.37	570.48	292	12.59	210
RESULTANT	26.05	679.84	293	21.04	210
RIGHT LAP LOADS (LB)					
X AXIS	18.03	619.23	293	11.40	192
Y AXIS	6.60	214.81	294	1.67	161
Z AXIS	21.17	619.51	293	12.23	163
RESULTANT	28.70	901.57	293	23.93	163
TOTAL LAP LOAD (LB)	54.75	1781.42	293	48.11	210
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-86.21	116.90	646	-141.59	408
SEAT LOADS (LB)					
Z AXIS (LEFT)	23.94	268.09	297	-15.17	498
Z AXIS (RIGHT)	35.87	357.76	299	-7.95	480
Z AXIS (CENTER)	120.95	879.38	295	104.73	220
Z AXIS (SUM)	180.16	1496.00	297	169.77	220

HORIZONTAL TEST PHASE

TEST: 2126

SUBJ: B-3

WT: 181.0

CELL: D

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			227		
TIME OF IMPACT START			290		
SLED ACCELERATION (G)					
X AXIS		0.60	445	-9.40	342
X AXIS (SMOOTHED)		0.47	448	-9.35	344
Y AXIS		0.47	343	-0.58	529
Z AXIS		2.36	462	0.03	353
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	273	-29.74	440
TACHOMETER (MEASURED)		0.15	237	-30.00	461
SEAT ACCELERATION (G)					
X AXIS		0.72	449	-10.20	341
X AXIS (SMOOTHED)		0.62	448	-9.85	340
Y AXIS		0.58	477	-0.69	482
Z AXIS		3.06	345	-1.27	340
CHEST ACCELERATION (G)					
X AXIS		10.90	484	-12.49	353
Y AXIS		2.16	471	-2.62	484
Z AXIS		10.60	347	-1.43	508
RESULTANT		15.32	348	0.31	595
CHEST SEVERITY INDEX		35.23			
HEAD ACCELERATION (G)					
X AXIS		4.28	405	-12.72	405
Y AXIS		2.20	548	-2.96	411
Z AXIS		8.97	483	-7.07	518
RESULTANT		14.05	405	0.70	648
HEAD SEVERITY INDEX		42.88			
NEGATIVE G STRAP		290.00	409	69.71	299
SHOULDER STRAP LOADS (LB)					
X AXIS	59.85	600.89	404	0.00	484
Y AXIS	4.71	27.80	365	-8.63	655
Z AXIS	20.73	229.39	367	3.11	468
RESULTANT	63.55	636.51	404	4.28	484
LEFT LAP LOADS (LB)					
X AXIS	54.76	683.02	358	16.97	715
Y AXIS	25.19	248.28	360	10.18	717
Z AXIS	69.38	650.77	358	31.12	719
RESULTANT	91.93	975.23	358	43.70	813
RIGHT LAP LOADS (LB)					
X AXIS	50.33	642.69	358	14.77	721
Y AXIS	17.96	218.56	359	6.70	696
Z AXIS	83.19	650.12	358	30.53	698
RESULTANT	82.80	939.06	358	40.41	698
TOTAL LAP LOAD (LB)	174.73	1914.29	358	87.61	698
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-59.76	176.04	554	-160.32	712
SEAT LOADS (LB)					
Z AXIS (LEFT)	79.62	462.35	361	-14.32	521
Z AXIS (RIGHT)	83.95	474.76	359	-12.35	707
Z AXIS (CENTER)	184.61	844.98	361	166.39	297
Z AXIS (SUM)	328.18	1780.58	361	223.10	506

HORIZONTAL TEST PHASE      TEST: 2112      SUBJ: C-2      WT: 185.0      CELL: D

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			161		
TIME OF IMPACT START			226		
SLED ACCELERATION (G)					
X AXIS		0.56	384	-9.56	280
X AXIS (SMOOTHED)		0.48	402	-9.42	279
Y AXIS		0.48	286	-0.47	492
Z AXIS		1.86	400	0.14	283
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	218	-29.65	380
TACHOMETER (MEASURED)		0.22	190	-29.93	403
SEAT ACCELERATION (G)					
X AXIS		0.66	389	-10.08	285
X AXIS (SMOOTHED)		0.59	388	-9.82	283
Y AXIS		0.68	414	-0.68	409
Z AXIS		2.53	288	-1.00	283
CHEST ACCELERATION (G)					
X AXIS		5.87	441	-19.47	294
Y AXIS		2.15	300	-4.86	291
Z AXIS		9.45	352	-8.08	328
RESULTANT		20.18	293	0.28	565
CHEST SEVERITY INDEX		48.73			
HEAD ACCELERATION (G)					
X AXIS		4.09	458	-21.29	315
Y AXIS		1.63	518	-1.27	347
Z AXIS		5.25	378	-9.69	306
RESULTANT		22.92	315	0.67	240
HEAD SEVERITY INDEX		85.94			
NEGATIVE G STRAP		272.61	327	23.45	204
SHOULDER STRAP LOADS (LB)					
X AXIS	19.25	764.91	312	-2.02	449
Y AXIS	0.75	30.58	358	-6.99	489
Z AXIS	8.95	267.15	303	-10.22	434
RESULTANT	21.40	808.09	312	1.95	430
LEFT LAP LOADS (LB)					
X AXIS	10.51	794.96	302	3.11	189
Y AXIS	3.64	256.56	303	-0.31	197
Z AXIS	11.88	747.41	302	2.23	211
RESULTANT	16.50	1120.63	302	11.60	211
RIGHT LAP LOADS (LB)					
X AXIS	10.55	760.84	302	4.82	170
Y AXIS	2.26	229.50	302	-3.93	233
Z AXIS	12.68	762.67	301	1.52	192
RESULTANT	16.80	1101.46	302	10.62	192
TOTAL LAP LOAD (LB)	33.31	2222.09	302	27.14	211
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	75.88	118.29	303	-27.47	445
SEAT LOADS (LB)					
Z AXIS (LEFT)	15.23	426.16	304	-13.95	536
Z AXIS (RIGHT)	45.62	476.22	303	-4.83	582
Z AXIS (CENTER)	126.30	1018.07	304	116.38	208
Z AXIS (SUM)	187.14	1920.45	304	140.51	457



HORIZONTAL TEST PHASE

TEST: 2159

SUBJ: E-2

WT: 171.0

CELL: D

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			182		
TIME OF IMPACT START			248		
SLED ACCELERATION (G)					
X AXIS		0.59	403	-9.58	298
X AXIS (SMOOTHED)		0.48	405	-9.49	302
Y AXIS		0.46	304	-0.42	494
Z AXIS		2.27	422	0.10	413
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	235	-29.84	399
TACHOMETER (MEASURED)		0.22	227	-30.05	420
SEAT ACCELERATION (G)					
X AXIS		0.74	410	-10.26	302
X AXIS (SMOOTHED)		0.60	408	-9.97	301
Y AXIS		0.54	419	-0.49	336
Z AXIS		2.87	408	-0.95	300
CHEST ACCELERATION (G)					
X AXIS		6.93	443	-17.19	315
Y AXIS		0.19	451	-2.74	323
Z AXIS		9.19	301	-2.80	465
RESULTANT		17.46	315	0.28	563
CHEST SEVERITY INDEX		42.02			
HEAD ACCELERATION (G)					
X AXIS		1.12	500	-12.12	332
Y AXIS		1.53	509	-1.18	336
Z AXIS		8.05	441	-5.62	375
RESULTANT		12.24	533	0.57	776
HEAD SEVERITY INDEX		36.14			
NEGATIVE G STRAP		284.88	329	39.49	780
SHOULDER STRAP LOADS (LB)					
X AXIS	46.29	785.70	324	10.87	441
Y AXIS	3.58	22.61	313	-10.41	605
Z AXIS	18.98	293.52	322	-0.88	445
RESULTANT	50.19	837.17	324	14.18	441
LEFT LAP LOADS (LB)					
X AXIS	25.75	703.84	322	15.59	220
Y AXIS	15.46	292.97	321	9.13	763
Z AXIS	34.79	703.37	322	23.95	771
RESULTANT	46.08	1037.28	322	34.43	771
RIGHT LAP LOADS (LB)					
X AXIS	24.31	658.46	322	7.94	773
Y AXIS	10.86	266.93	323	3.05	731
Z AXIS	30.16	688.73	322	15.80	764
RESULTANT	40.29	989.19	322	21.79	779
TOTAL LAP LOAD (LB)	86.37	2026.47	322	59.03	771
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-87.04	99.72	531	-69.08	181
SEAT LOADS (LB)					
Z AXIS (LEFT)	49.52	412.70	326	-13.71	614
Z AXIS (RIGHT)	53.11	393.21	323	-10.44	504
Z AXIS (CENTER)	129.27	1024.51	321	107.33	257
Z AXIS (SUM)	231.91	1818.26	322	220.12	251

HORIZONTAL TEST PHASE

TEST: 2130

SUBJ: F-2

WT: 153.0

CELL: D

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			199		
TIME OF IMPACT START			265		
SLED ACCELERATION (G)					
X AXIS		0.49	418	-9.44	319
X AXIS (SMOOTHED)		0.96	420	-9.41	319
Y AXIS		0.47	320	-0.35	528
Z AXIS		1.98	436	0.15	329
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	250	-29.65	414
TACHOMETER (MEASURED)		0.16	204	-30.17	439
SEAT ACCELERATION (G)					
X AXIS		0.60	422	-10.10	317
X AXIS (SMOOTHED)		0.51	422	-9.68	316
Y AXIS		0.62	430	-0.62	443
Z AXIS		2.71	321	-0.96	316
CHEST ACCELERATION (G)					
X AXIS		4.46	454	-15.55	330
Y AXIS		2.04	338	-2.29	472
Z AXIS		11.69	374	-2.07	349
RESULTANT		15.79	330	0.71	650
CHEST SEVERITY INDEX		37.23			
HEAD ACCELERATION (G)					
X AXIS		0.77	522	-11.86	385
Y AXIS		1.32	334	0.09	429
Z AXIS		4.00	444	-9.68	383
RESULTANT		15.16	385	0.66	560
HEAD SEVERITY INDEX		42.15			
NEGATIVE G STRAP		194.38	388	65.72	785
SHOULDER STRAP LOADS (LB)					
X AXIS	56.02	597.13	337	16.01	455
Y AXIS	1.23	22.13	328	-4.05	445
Z AXIS	21.26	230.80	338	2.09	463
RESULTANT	59.98	639.58	337	16.72	455
LEFT LAP LOADS (LB)					
X AXIS	34.39	596.53	335	11.89	727
Y AXIS	14.90	227.19	337	5.51	745
Z AXIS	41.68	592.23	335	20.40	763
RESULTANT	56.10	870.75	337	30.31	774
RIGHT LAP LOADS (LB)					
X AXIS	32.95	530.37	335	10.45	734
Y AXIS	13.24	221.05	338	4.11	752
Z AXIS	40.58	565.14	334	19.41	770
RESULTANT	54.02	805.25	336	30.56	770
TOTAL LAP LOAD (LB)	110.12	1675.69	336	65.57	770
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	54.94	99.21	336	48.14	447
SEAT LOADS (LB)					
Z AXIS (LEFT)	44.93	351.09	339	-5.27	558
Z AXIS (RIGHT)	50.44	326.20	339	-3.10	694
Z AXIS (CENTER)	140.18	723.33	336	125.31	219
Z AXIS (SUM)	235.55	1388.45	337	220.30	242

HORIZONTAL TEST PHASE		TEST: 2104	SUBJ: G-3	WT: 165.0	CELL: 0
PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			201		
TIME OF IMPACT START			260		
SLED ACCELERATION (G)					
X AXIS		0.58	414	-9.64	308
X AXIS (SMOOTHED)		0.40	415	-9.51	309
Y AXIS		0.48	315	-0.68	501
Z AXIS		1.99	429	0.07	312
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	248	-30.01	410
TACHOMETER (MEASURED)		0.29	247	-30.27	435
SEAT ACCELERATION (G)					
X AXIS		0.71	417	-10.15	313
X AXIS (SMOOTHED)		0.61	417	-9.91	312
Y AXIS		0.76	469	-0.50	464
Z AXIS		2.75	317	-1.00	312
CHEST ACCELERATION (G)					
X AXIS		3.33	445	-15.45	324
Y AXIS		6.78	329	-2.31	373
Z AXIS		14.53	370	-7.81	351
RESULTANT		17.29	325	0.44	781
CHEST SEVERITY INDEX		47.35			
HEAD ACCELERATION (G)					
X AXIS		2.12	477	-13.95	375
Y AXIS		1.94	456	-0.10	438
Z AXIS		2.19	407	-12.99	344
RESULTANT		17.22	371	0.41	734
HEAD SEVERITY INDEX		63.51			
NEGATIVE G STRAP		245.23	383	37.49	797
SHOULDER STRAP LOADS (LB)					
X AXIS	38.46	632.79	333	-3.68	481
Y AXIS	2.98	11.50	313	-6.72	476
Z AXIS	18.83	271.38	331	-5.99	478
RESULTANT	42.96	687.60	333	1.35	477
LEFT LAP LOADS (LB)					
X AXIS	16.48	709.07	328	6.02	204
Y AXIS	7.20	316.10	329	1.76	227
Z AXIS	19.17	681.14	329	9.68	755
RESULTANT	26.47	1032.78	329	21.11	755
RIGHT LAP LOADS (LB)					
X AXIS	18.18	716.23	330	10.45	786
Y AXIS	7.43	285.73	329	4.08	212
Z AXIS	23.76	741.09	329	18.92	747
RESULTANT	30.95	1068.08	330	28.11	747
TOTAL LAP LOAD (LB)	57.41	2100.86	330	51.85	243
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	44.98	72.29	332	-6.19	663
SEAT LOADS (LB)					
Z AXIS (LEFT)	20.95	308.60	333	-12.73	436
Z AXIS (RIGHT)	35.38	422.14	331	6.34	460
Z AXIS (CENTER)	139.75	964.96	333	131.44	265
Z AXIS (SUM)	196.06	1694.17	333	173.98	771

HORIZONTAL TEST PHASE

TEST: 2067

SUBJ: M-6

WT: 188.0

CELL: D

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			295		
TIME OF IMPACT START			300		
SLED ACCELERATION (G)					
X AXIS		0.64	474	-9.58	352
X AXIS (SMOOTHED)		0.51	474	-9.42	351
Y AXIS		0.60	346	-0.64	540
Z AXIS		2.56	353	-0.87	348
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	295	-29.65	450
TACHOMETER (MEASURED)		0.23	239	-30.04	476
SEAT ACCELERATION (G)					
X AXIS		0.77	457	-12.86	331
X AXIS (SMOOTHED)		0.60	457	-9.77	354
Y AXIS		0.94	563	-1.23	348
Z AXIS		4.43	352	-2.60	348
CHEST ACCELERATION (G)					
X AXIS		9.73	516	-18.57	363
Y AXIS		0.78	434	-3.17	355
Z AXIS		11.70	355	-6.25	544
RESULTANT		19.17	364	0.27	620
CHEST SEVERITY INDEX		45.42			
HEAD ACCELERATION (G)					
X AXIS		9.86	552	-17.43	379
Y AXIS		3.34	594	-4.34	553
Z AXIS		3.59	440	-13.28	551
RESULTANT		21.65	381	1.05	310
HEAD SEVERITY INDEX		71.66			
NEGATIVE G STRAP		317.88	384	22.91	233
SHOULDER STRAP LOADS (LB)					
X AXIS	23.24	932.25	374	-6.64	510
Y AXIS	1.68	55.24	370	-22.18	431
Z AXIS	11.78	334.79	371	-8.27	520
RESULTANT	26.24	991.26	375	1.71	507
LEFT LAP LOADS (LB)					
X AXIS	14.90	725.74	369	5.43	787
Y AXIS	8.33	256.37	370	4.20	283
Z AXIS	17.29	673.44	368	9.96	254
RESULTANT	24.48	1022.43	369	20.84	254
RIGHT LAP LOADS (LB)					
X AXIS	16.33	699.10	369	3.37	805
Y AXIS	5.18	193.90	370	-1.47	233
Z AXIS	19.49	704.81	369	7.26	815
RESULTANT	26.05	1010.05	369	16.44	815
TOTAL LAP LOAD (LB)	50.52	2032.48	369	43.25	241
SEAT LINK LOADS (LB)					
SEAT LOADS (LB)					
Z AXIS (LEFT)	34.02	428.45	369	-1.01	483
Z AXIS (RIGHT)	35.27	449.66	368	-8.62	623
Z AXIS (CENTER)	129.09	1044.41	367	117.93	251
Z AXIS (SUM)	198.37	1914.91	367	143.56	529

HORIZONTAL TEST PHASE

TEST: 2062

SUBJ: J-3

WT: 167.0

CELL: D

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			221		
TIME OF IMPACT START			278		
SLED ACCELERATION (G)					
X AXIS		0.56	431	-9.47	330
X AXIS (SMOOTHED)		0.45	434	-9.40	328
Y AXIS		0.48	341	-0.55	516
Z AXIS		2.04	450	0.12	442
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	240	-29.86	428
TACHOMETER (MEASURED)		0.11	225	-30.16	451
SEAT ACCELERATION (G)					
X AXIS		0.82	435	-10.22	330
X AXIS (SMOOTHED)		0.60	435	-9.85	329
Y AXIS		0.63	449	-0.69	363
Z AXIS		2.95	437	-0.98	442
CHEST ACCELERATION (G)					
X AXIS		5.53	472	-15.60	342
Y AXIS		1.13	412	-2.17	453
Z AXIS		10.05	396	-4.63	373
RESULTANT		16.63	341	0.58	559
CHEST SEVERITY INDEX		41.25			
HEAD ACCELERATION (G)					
X AXIS		1.01	564	-17.42	402
Y AXIS		1.83	545	-1.74	462
Z AXIS		6.57	466	-16.21	366
RESULTANT		20.38	366	0.82	574
HEAD SEVERITY INDEX		84.24			
NEGATIVE G STRAP		179.80	363	38.59	767
SHOULDER STRAP LOADS (LB)					
X AXIS	38.54	619.82	352	-6.76	481
Y AXIS	2.03	28.12	340	-6.03	483
Z AXIS	13.58	217.66	349	-3.75	478
RESULTANT	40.99	655.89	352	1.64	492
LEFT LAP LOADS (LB)					
X AXIS	29.50	698.90	346	22.99	224
Y AXIS	12.71	250.53	348	7.74	226
Z AXIS	35.11	614.75	346	26.98	228
RESULTANT	47.65	963.62	346	41.14	228
RIGHT LAP LOADS (LB)					
X AXIS	29.89	672.98	346	19.94	230
Y AXIS	7.84	173.73	347	2.46	232
Z AXIS	34.67	648.11	346	24.41	254
RESULTANT	46.54	949.87	346	39.66	254
TOTAL LAP LOAD (LB)	94.19	1913.49	346	87.82	228
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	41.37	59.21	348	-0.59	726
SEAT LOADS (LB)					
Z AXIS (LEFT)	38.74	345.57	350	-7.74	455
Z AXIS (RIGHT)	82.43	426.26	351	10.47	563
Z AXIS (CENTER)	111.43	846.78	349	100.02	258
Z AXIS (SUM)	212.60	1614.05	349	178.22	483

HORIZONTAL TEST PHASE

TEST: 2140

SUBJ: J-4

WT: 181.0

CELL: D

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			166		
TIME OF IMPACT START			232		
SLED ACCELERATION (G)					
X AXIS		0.65	386	-9.54	283
X AXIS (SMOOTHED)		0.50	387	-9.50	284
Y AXIS		0.50	286	-0.47	478
Z AXIS		2.08	403	-0.11	281
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION	0.01	207		-30.01	381
TACHOMETER (MEASURED)	0.11	166		-30.28	407
SEAT ACCELERATION (G)					
X AXIS		0.76	391	-10.27	282
X AXIS (SMOOTHED)		0.64	389	-9.96	283
Y AXIS		0.60	416	-0.74	411
Z AXIS		3.18	287	-1.30	282
CHEST ACCELERATION (G)					
X AXIS		5.09	419	-16.54	298
Y AXIS		0.63	300	-2.33	449
Z AXIS		7.07	280	-2.04	461
RESULTANT		17.50	299	0.18	509
CHEST SEVERITY INDEX		38.51			
HEAD ACCELERATION (G)					
X AXIS		0.65	197	-10.00	346
Y AXIS		0.58	446	-1.82	355
Z AXIS		5.12	410	-1.39	459
RESULTANT		10.18	347	0.32	241
HEAD SEVERITY INDEX		51.11			
NEGATIVE G STRAP		237.85	355	53.96	749
SHOULDER STRAP LOADS (LB)					
X AXIS	77.80	680.27	310	29.97	467
Y AXIS	0.39	17.06	282	-15.96	551
Z AXIS	14.99	173.04	308	-2.14	439
RESULTANT	79.28	701.35	310	32.83	422
LEFT LAP LOADS (LB)					
X AXIS	49.44	778.03	299	24.17	746
Y AXIS	22.43	289.43	300	10.27	748
Z AXIS	68.38	798.97	298	33.87	756
RESULTANT	87.94	1152.53	299	43.16	759
RIGHT LAP LOADS (LB)					
X AXIS	50.43	744.97	298	16.58	758
Y AXIS	14.94	228.79	299	1.70	760
Z AXIS	87.99	789.26	298	28.11	749
RESULTANT	86.01	1107.71	299	35.34	758
TOTAL LAP LOAD (LB)	173.35	2260.23	299	82.00	758
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-59.65	13.48	645	-109.85	554
SEAT LOADS (LB)					
Z AXIS (LEFT)	60.00	462.84	303	-13.83	560
Z AXIS (RIGHT)	73.80	488.82	303	-12.23	524
Z AXIS (CENTER)	214.55	1141.39	302	190.13	450
Z AXIS (SUM)	348.15	2073.04	303	188.38	450

HORIZONTAL TEST PHASE

TEST: 2073

SUBJ: K-1

WT: 176.0

CELL: D

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			234		
TIME OF IMPACT START			293		
SLED ACCELERATION (G)					
X AXIS		0.58	447	-9.66	344
X AXIS (SMOOTHED)		0.42	448	-9.48	344
Y AXIS		0.50	338	-0.63	530
Z AXIS		2.45	346	-0.79	340
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.02	278	-29.73	443
TACHOMETER (MEASURED)		0.16	257	-30.11	466
SEAT ACCELERATION (G)					
X AXIS		0.77	449	-12.35	324
X AXIS (SMOOTHED)		0.57	450	-9.84	347
Y AXIS		0.87	616	-1.25	340
Z AXIS		4.45	345	-2.65	340
CHEST ACCELERATION (G)					
X AXIS		5.44	493	-14.35	356
Y AXIS		0.99	410	-4.39	467
Z AXIS		12.08	348	-6.60	386
RESULTANT		15.39	358	0.29	509
CHEST SEVERITY INDEX		47.53			
HEAD ACCELERATION (G)					
X AXIS		1.78	527	-17.05	378
Y AXIS		1.76	505	-1.66	406
Z AXIS		4.39	442	-20.05	378
RESULTANT		26.33	378	0.55	624
HEAD SEVERITY INDEX		70.94			
NEGATIVE G STRAP		255.01	372	28.44	821
SHOULDER STRAP LOADS (LB)					
X AXIS	25.38	863.93	370	-5.77	493
Y AXIS	1.46	23.50	368	-9.52	573
Z AXIS	11.68	297.61	368	-6.52	510
RESULTANT	28.07	914.00	370	0.89	504
LEFT LAP LOADS (LB)					
X AXIS	18.70	733.09	365	2.91	721
Y AXIS	10.88	253.30	365	5.82	239
Z AXIS	21.32	641.77	364	10.16	783
RESULTANT	30.47	1008.70	365	17.23	796
RIGHT LAP LOADS (LB)					
X AXIS	20.65	720.00	364	6.68	798
Y AXIS	5.51	171.09	366	-1.45	251
Z AXIS	23.14	681.55	364	14.77	776
RESULTANT	31.58	1005.64	364	24.71	824
TOTAL LAP LOAD (LB)	62.05	2010.74	365	45.03	796
SEAT LINK LOADS (LB)					
SEAT LOADS (LB)					
Z AXIS (LEFT)	37.43	416.87	364	-11.06	608
Z AXIS (RIGHT)	56.15	517.04	365	2.61	765
Z AXIS (CENTER)	102.07	859.36	365	90.91	282
Z AXIS (SUM)	195.65	1793.27	365	142.46	511

HORIZONTAL TEST PHASE		TEST: 2155	SUBJ: M13	WT: 176.0	CELL: D
PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			234		
TIME OF IMPACT START			304		
SLED ACCELERATION (G)					
X AXIS		0.61	460	-9.61	358
X AXIS (SMOOTHED)		0.47	460	-8.56	362
Y AXIS		0.47	357	-0.31	560
Z AXIS		2.22	477	-0.11	353
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.02	268	-30.04	454
TACHOMETER (MEASURED)		0.21	258	-30.29	479
SEAT ACCELERATION (G)					
X AXIS		0.71	464	-10.17	354
X AXIS (SMOOTHED)		0.59	463	-9.92	355
Y AXIS		0.68	480	-0.50	484
Z AXIS		3.17	358	-1.43	353
CHEST ACCELERATION (G)					
X AXIS		3.35	500	-12.26	382
Y AXIS		0.61	473	-1.66	554
Z AXIS		7.36	421	-0.98	461
RESULTANT		12.98	383	0.19	548
CHEST SEVERITY INDEX		30.57			
HEAD ACCELERATION (G)					
X AXIS		0.79	558	-9.74	388
Y AXIS		1.73	558	-2.17	438
Z AXIS		3.95	497	-9.01	440
RESULTANT		11.54	441	0.63	522
HEAD SEVERITY INDEX		26.03			
NEGATIVE G STRAP		212.29	436	64.18	344
SHOULDER STRAP LOADS (LB)					
X AXIS	96.89	606.86	381	43.52	504
Y AXIS	11.04	38.28	371	-9.68	483
Z AXIS	30.27	199.22	381	4.57	496
RESULTANT	102.14	639.73	381	45.99	504
LEFT LAP LOADS (LB)					
X AXIS	86.80	579.80	366	29.70	807
Y AXIS	24.28	183.94	367	13.86	786
Z AXIS	75.95	546.01	368	37.94	816
RESULTANT	104.04	817.99	368	57.51	816
RIGHT LAP LOADS (LB)					
X AXIS	61.39	552.27	368	22.30	829
Y AXIS	19.38	169.19	368	5.53	825
Z AXIS	89.51	541.79	367	30.94	821
RESULTANT	94.79	791.94	368	48.43	821
TOTAL LAP LOAD (LB)	188.83	1609.33	368	111.48	821
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	-68.88	-15.83	715	-70.65	249
SEAT LOADS (LB)					
Z AXIS (LEFT)	69.90	358.03	372	-12.03	668
Z AXIS (RIGHT)	72.66	382.23	375	-7.77	561
Z AXIS (CENTER)	137.76	650.39	360	120.53	269
Z AXIS (SUM)	280.32	1389.13	372	254.89	830



## HORIZONTAL TEST PHASE

TEST: 2136

SUBJ: P-3

WT: 201.0

CELL: D

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			169		
TIME OF IMPACT START			291		
SLED ACCELERATION (G)					
X AXIS		0.68	384	-9.61	276
X AXIS (SMOOTHED)		0.55	388	-9.49	279
Y AXIS		0.48	286	-0.54	489
Z AXIS		1.69	402	0.17	282
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.02	218	-29.91	360
TACHOMETER (MEASURED)		0.23	182	-30.16	403
SEAT ACCELERATION (G)					
X AXIS		0.67	391	-10.17	283
X AXIS (SMOOTHED)		0.64	389	-9.94	282
Y AXIS		0.80	529	-0.69	330
Z AXIS		2.54	287	-1.01	282
CHEST ACCELERATION (G)					
X AXIS		4.15	419	-17.26	297
Y AXIS		2.75	369	-3.49	308
Z AXIS		12.18	855	-8.60	335
RESULTANT		18.17	297	0.05	597
CHEST SEVERITY INDEX		53.86			
HEAD ACCELERATION (G)					
X AXIS		2.31	491	-13.52	369
Y AXIS		1.43	539	-2.29	366
Z AXIS		2.59	402	-16.02	320
RESULTANT		19.69	322	0.39	749
HEAD SEVERITY INDEX		68.74			
NEGATIVE G STRAP		232.54	380	44.89	759
SHOULDER STRAP LOADS (LB)					
X AXIS	39.45	861.72	307	-0.08	462
Y AXIS	1.84	49.75	304	-12.87	518
Z AXIS	6.28	170.46	307	-9.59	525
RESULTANT	40.03	879.64	307	2.41	447
LEFT LAP LOADS (LB)					
X AXIS	22.79	821.75	299	20.03	163
Y AXIS	7.20	266.51	300	1.43	175
Z AXIS	28.97	806.42	299	25.38	161
RESULTANT	37.60	1181.78	300	34.69	161
RIGHT LAP LOADS (LB)					
X AXIS	18.59	764.96	299	6.43	220
Y AXIS	8.52	246.75	299	1.90	760
Z AXIS	25.38	796.65	299	23.39	160
RESULTANT	32.25	1131.82	299	27.15	220
TOTAL LAP LOAD (LB)	69.85	2313.34	299	84.41	177
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	4.86	140.17	584	3.14	161
SEAT LOADS (LB)					
Z AXIS (LEFT)	51.29	521.50	301	-3.90	453
Z AXIS (RIGHT)	85.25	543.51	303	-10.38	577
Z AXIS (CENTER)	142.60	1015.16	303	135.16	236
Z AXIS (SUM)	259.14	2075.59	303	156.18	449

HORIZONTAL TEST PHASE		TEST: 2103	SUBJ: R-2	WT: 143.0	CELL: D
PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			179		
TIME OF IMPACT START			236		
SLED ACCELERATION (G)					
X AXIS		0.50	388	-9.53	282
X AXIS (SMOOTHED)		0.30	405	-9.44	284
Y AXIS		0.47	286	-0.41	502
Z AXIS		1.48	402	0.11	287
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.02	223	-30.04	385
TACHOMETER (MEASURED)		0.21	228	-30.41	410
SEAT ACCELERATION (G)					
X AXIS		0.58	394	-10.08	288
X AXIS (SMOOTHED)		0.45	392	-9.88	288
Y AXIS		0.72	397	-0.64	356
Z AXIS		2.82	293	-1.06	288
CHEST ACCELERATION (G)					
X AXIS		5.85	415	-19.45	296
Y AXIS		1.69	410	-3.84	393
Z AXIS		7.53	286	-1.23	518
RESULTANT		20.82	296	0.74	637
CHEST SEVERITY INDEX		46.90			
HEAD ACCELERATION (G)					
X AXIS		2.88	505	-16.15	323
Y AXIS		1.31	491	-2.35	325
Z AXIS		3.07	400	-19.28	314
RESULTANT		24.79	318	0.61	243
HEAD SEVERITY INDEX		101.07			
NEGATIVE G STRAP		257.96	320	17.59	244
SHOULDER STRAP LOADS (LB)					
X AXIS	19.25	659.99	315	-6.13	481
Y AXIS	1.94	24.48	302	-8.54	658
Z AXIS	11.68	276.30	311	-1.07	478
RESULTANT	22.66	713.84	315	4.04	485
LEFT LAP LOADS (LB)					
X AXIS	12.63	561.45	300	8.88	192
Y AXIS	6.50	252.71	302	1.71	229
Z AXIS	13.63	580.44	299	6.61	217
RESULTANT	19.88	845.82	300	15.16	217
RIGHT LAP LOADS (LB)					
X AXIS	12.61	563.27	299	3.16	198
Y AXIS	6.75	274.64	301	0.61	186
Z AXIS	16.04	622.42	299	6.94	174
RESULTANT	21.71	882.45	299	17.03	174
TOTAL LAP LOAD (LB)	41.59	1727.88	300	37.20	174
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	74.00	123.95	307	-121.46	566
SEAT LOADS (LB)					
Z AXIS (LEFT)	9.53	166.51	305	-14.71	421
Z AXIS (RIGHT)	31.14	324.99	298	-16.45	496
Z AXIS (CENTER)	113.22	1001.52	306	106.03	240
Z AXIS (SUM)	153.89	1493.50	306	149.38	191

HORIZONTAL TEST PHASE

TEST: 2093

SUBJ: R-3

WT: 150.0

CELL: D

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			180		
TIME OF IMPACT START			237		
SLED ACCELERATION (G)					
X AXIS		0.57	390	-9.43	285
X AXIS (SMOOTHED)		0.39	391	-9.37	286
Y AXIS		0.48	291	-0.51	478
Z AXIS		1.91	406	0.17	288
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.01	217	-29.91	386
TACHOMETER (MEASURED)		0.28	229	-30.17	412
SEAT ACCELERATION (G)					
X AXIS		0.70	395	-10.05	289
X AXIS (SMOOTHED)		0.59	393	-9.65	288
Y AXIS		0.75	445	-0.61	356
Z AXIS		2.65	293	-0.84	288
CHEST ACCELERATION (G)					
X AXIS		4.87	416	-13.62	301
Y AXIS		0.55	438	-3.11	426
Z AXIS		7.60	295	-3.09	448
RESULTANT		14.13	297	0.51	436
CHEST SEVERITY INDEX		32.56			
HEAD ACCELERATION (G)					
X AXIS		2.32	476	-12.86	351
Y AXIS		0.47	532	-2.16	353
Z AXIS		1.99	422	-10.42	317
RESULTANT		15.73	317	0.11	435
HEAD SEVERITY INDEX		45.97			
NEGATIVE G STRAP		203.91	319	35.08	701
SHOULDER STRAP LOADS (LB)					
X AXIS	66.33	673.55	309	-6.40	455
Y AXIS	6.40	38.60	303	-4.67	457
Z AXIS	34.99	306.81	307	-7.06	459
RESULTANT	75.30	741.02	309	1.15	439
LEFT LAP LOADS (LB)					
X AXIS	41.84	539.74	309	19.24	740
Y AXIS	20.20	225.74	307	11.10	742
Z AXIS	50.73	534.09	307	28.01	744
RESULTANT	68.82	790.49	307	42.22	744
RIGHT LAP LOADS (LB)					
X AXIS	37.93	501.99	306	19.74	773
Y AXIS	17.13	205.65	305	9.01	640
Z AXIS	46.86	523.90	306	29.46	777
RESULTANT	62.75	754.16	306	42.15	777
TOTAL LAP LOAD (LB)	131.57	1542.97	306	88.13	777
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	76.05	111.31	307	-96.73	417
SEAT LOADS (LB)					
Z AXIS (LEFT)	14.80	222.52	309	-13.52	406
Z AXIS (RIGHT)	32.57	286.47	310	-0.33	759
Z AXIS (CENTER)	177.30	791.44	308	162.43	189
Z AXIS (SUM)	224.67	1297.39	308	183.88	761

HORIZONTAL TEST PHASE      TEST: 2150      SLBJ: T-1      WT: 166.0      CELL: 0

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			180		
TIME OF IMPACT START			248		
SLED ACCELERATION (G)					
X AXIS		0.59	400	-9.56	294
X AXIS (SMOOTHED)		3.40	401	-9.50	297
Y AXIS		0.47	297	-0.35	501
Z AXIS		1.82	417	0.11	299
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	230	-29.98	396
TACHOMETER (MEASURED)		0.22	187	-30.29	423
SEAT ACCELERATION (G)					
X AXIS		0.65	401	-10.19	300
X AXIS (SMOOTHED)		0.48	402	-9.95	299
Y AXIS		0.53	398	-0.65	367
Z AXIS		2.71	304	-1.07	299
CHEST ACCELERATION (G)					
X AXIS		6.60	429	-14.78	309
Y AXIS		1.51	429	-3.06	415
Z AXIS		6.18	306	-0.93	456
RESULTANT		15.71	307	0.28	651
CHEST SEVERITY INDEX		34.36			
HEAD ACCELERATION (G)					
X AXIS		1.73	462	-11.99	366
Y AXIS		1.10	463	-1.32	343
Z AXIS		7.43	423	-3.76	339
RESULTANT		12.20	366	0.47	446
HEAD SEVERITY INDEX		36.10			
NEGATIVE G STRAP		267.59	466	59.22	779
SHOULDER STRAP LOADS (LB)					
X AXIS	74.83	756.37	324	27.00	453
Y AXIS	1.64	20.81	317	-8.79	369
Z AXIS	29.68	284.57	326	4.77	739
RESULTANT	80.55	808.34	326	30.65	453
LEFT LAP LOADS (LB)					
X AXIS	34.24	580.89	317	23.39	764
Y AXIS	12.34	204.46	319	8.59	222
Z AXIS	41.92	573.98	316	32.04	775
RESULTANT	55.57	841.56	317	46.37	775
RIGHT LAP LOADS (LB)					
X AXIS	34.86	584.32	316	21.70	226
Y AXIS	14.97	229.63	318	10.15	194
Z AXIS	49.74	607.12	315	36.77	230
RESULTANT	58.01	873.02	316	49.17	777
TOTAL LAP LOAD (LB)	113.58	1712.90	317	98.10	775
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	86.10	134.01	318	-14.86	430
SEAT LOADS (LB)					
Z AXIS (LEFT)	43.46	328.61	318	-15.56	568
Z AXIS (RIGHT)	38.09	356.40	320	-1.73	520
Z AXIS (CENTER)	177.36	884.21	319	165.34	207
Z AXIS (SUM)	258.91	1567.69	320	233.95	751

## HORIZONTAL TEST PHASE

TEST: 2143

SUBJ: W-4

WT: 194.0

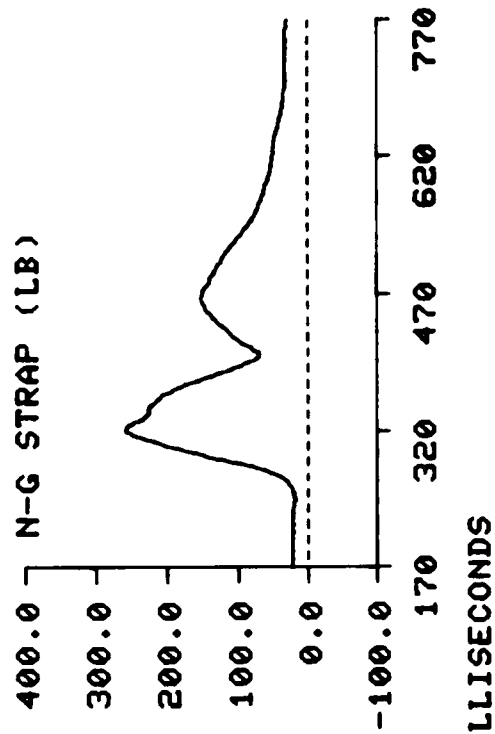
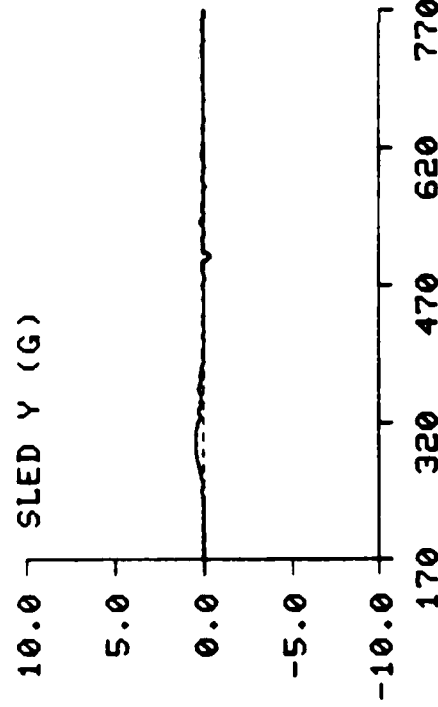
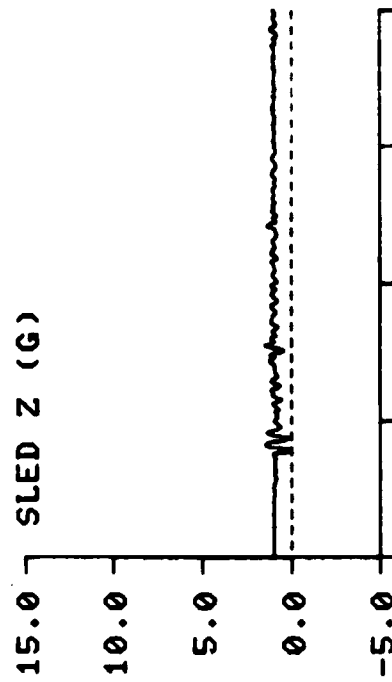
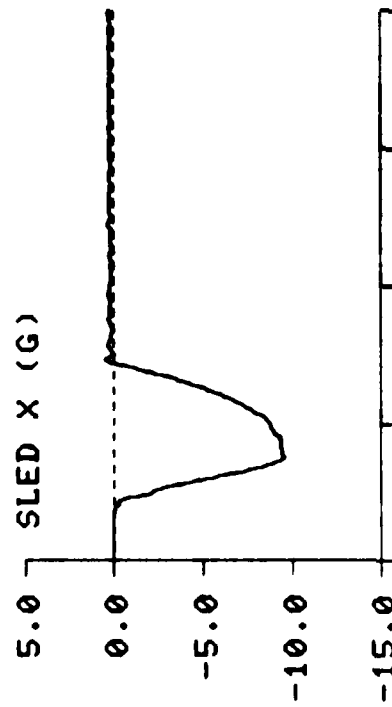
CELL: D

PARAMETER	PREIMPACT AVERAGE	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK			158		
TIME OF IMPACT START			233		
SLED ACCELERATION (G)					
X AXIS		0.64	408	-9.63	287
X AXIS (SMOOTHED)		0.50	388	-9.49	285
Y AXIS		0.47	287	-0.71	476
Z AXIS		2.11	408	0.02	400
SLED VELOCITY (FT/SEC)					
INTEGRATED ACCELERATION		0.00	150	-29.90	382
TACHOMETER (MEASURED)		0.34	196	-30.16	407
SEAT ACCELERATION (G)					
X AXIS		0.94	396	-10.23	285
X AXIS (SMOOTHED)		0.60	395	-9.95	284
Y AXIS		0.89	406	-0.82	428
Z AXIS		3.51	395	-1.32	401
CHEST ACCELERATION (G)					
X AXIS		12.39	436	-18.58	298
Y AXIS		2.68	438	-3.39	295
Z AXIS		7.43	350	-5.22	460
RESULTANT		18.95	298	0.60	483
CHEST SEVERITY INDEX		51.22			
HEAD ACCELERATION (G)					
X AXIS		6.65	445	-10.55	302
Y AXIS		0.91	452	-2.15	366
Z AXIS		11.65	439	-4.47	468
RESULTANT		12.73	441	0.61	640
HEAD SEVERITY INDEX		35.98			
NEGATIVE G STRAP	118.75	437.68	358	88.10	696
SHOULDER STRAP LOADS (LB)					
X AXIS	85.07	761.78	304	-3.16	441
Y AXIS	6.08	33.45	301	-14.37	358
Z AXIS	28.13	265.40	303	-2.24	430
RESULTANT	89.84	807.34	304	1.08	429
LEFT LAP LOADS (LB)					
X AXIS	31.03	794.96	305	8.04	739
Y AXIS	13.70	313.17	304	4.69	687
Z AXIS	44.47	847.82	304	18.97	728
RESULTANT	56.00	1202.28	305	26.60	728
RIGHT LAP LOADS (LB)					
X AXIS	30.44	810.97	304	7.23	707
Y AXIS	8.86	273.50	304	2.00	214
Z AXIS	40.79	879.33	304	19.70	673
RESULTANT	51.72	1227.07	304	28.81	673
TOTAL LAP LOAD (LB)	107.72	2427.49	304	63.21	739
SEAT LINK LOADS (LB)					
Y AXIS (CENTER)	13.89	117.16	448	-18.62	700
SEAT LOADS (LB)					
Z AXIS (LEFT)	52.33	466.98	309	-9.69	704
Z AXIS (RIGHT)	63.40	598.65	306	-11.38	418
Z AXIS (CENTER)	201.22	1277.88	308	184.37	236
Z AXIS (SUM)	316.95	2292.87	308	288.43	454

# RESTRAINT CONFIGURATION STUDY

TEST NO: 2103

SUBJ ID: R-2

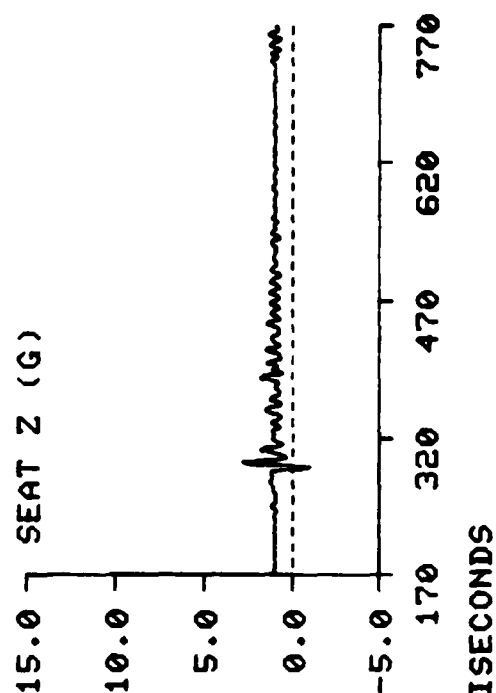
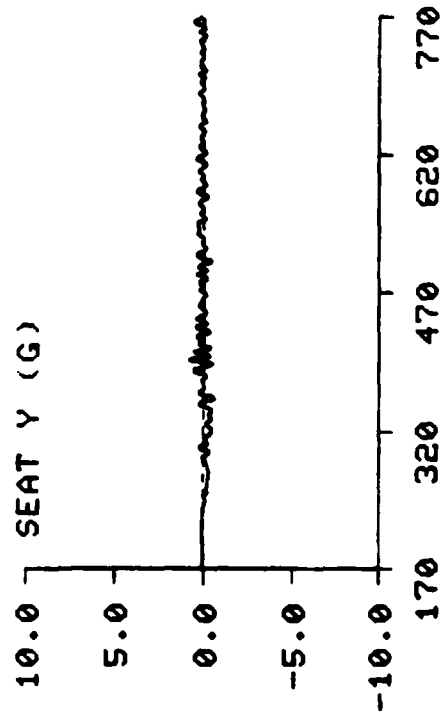
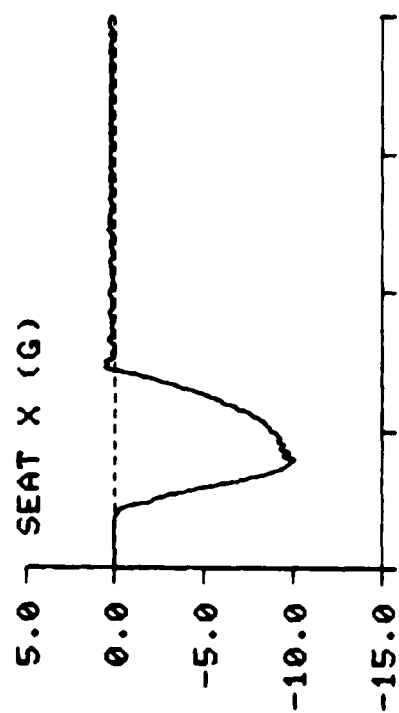


TIME IN MILLISECONDS

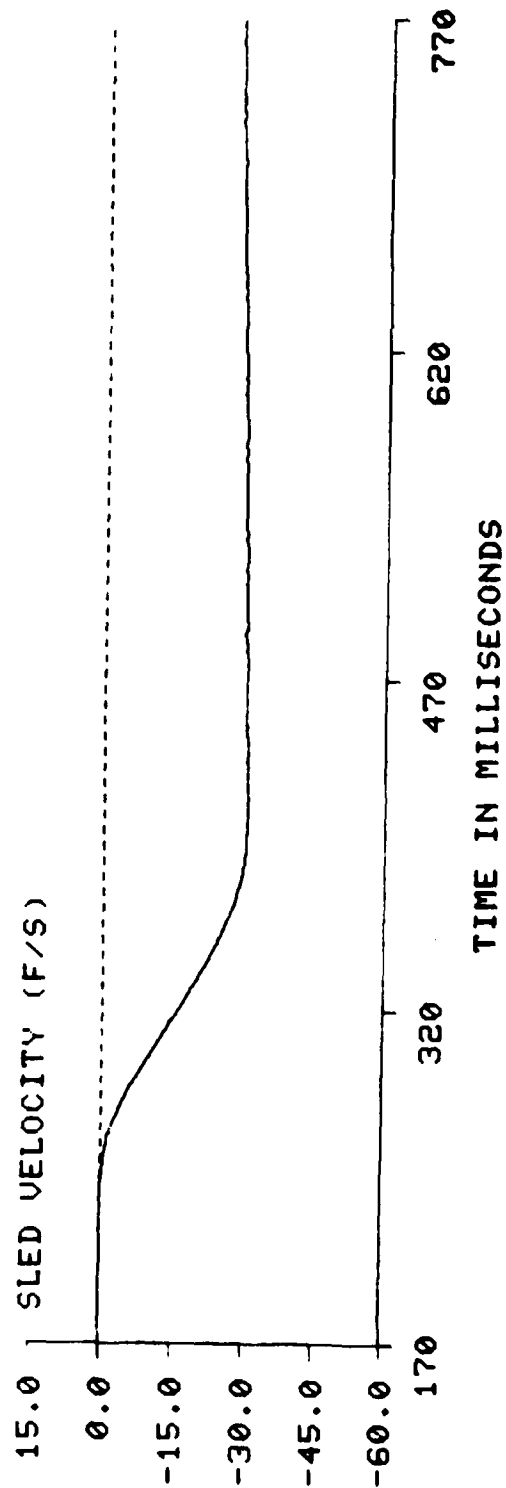
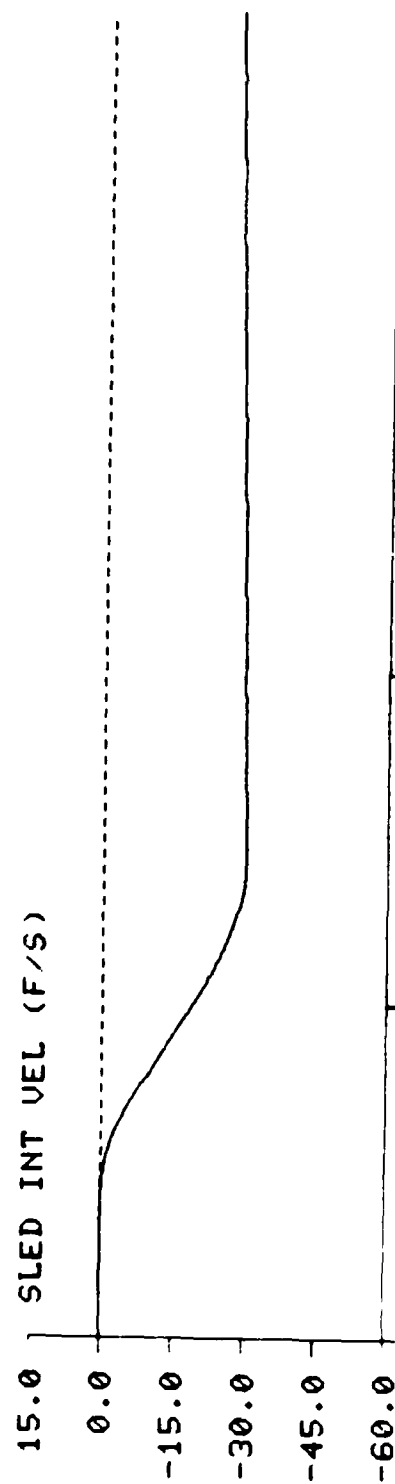
# RESTRAINT CONFIGURATION STUDY

TEST NO: 2103

SUBJ ID: R-2



RESTRAINT CONFIGURATION STUDY      TEST NO: 2103      SUBJ ID: R-2

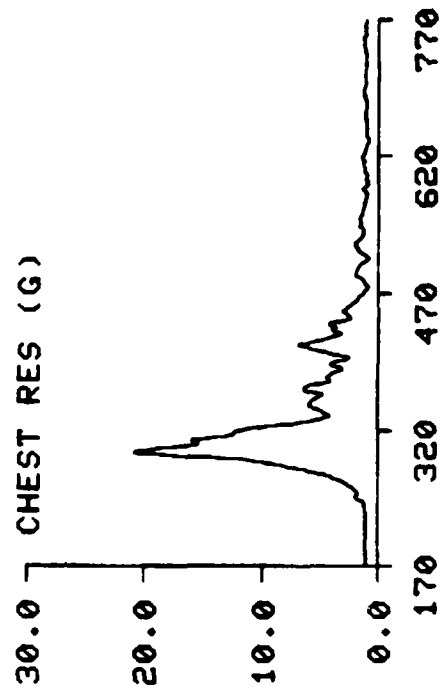
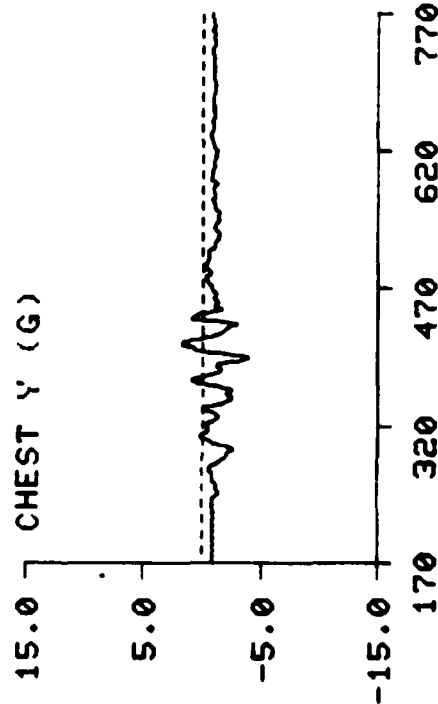
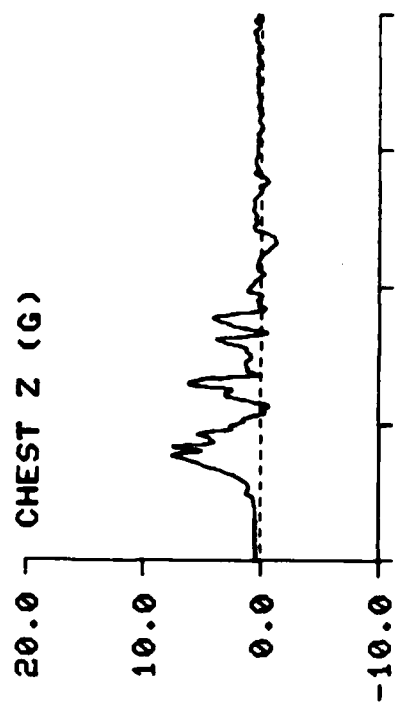
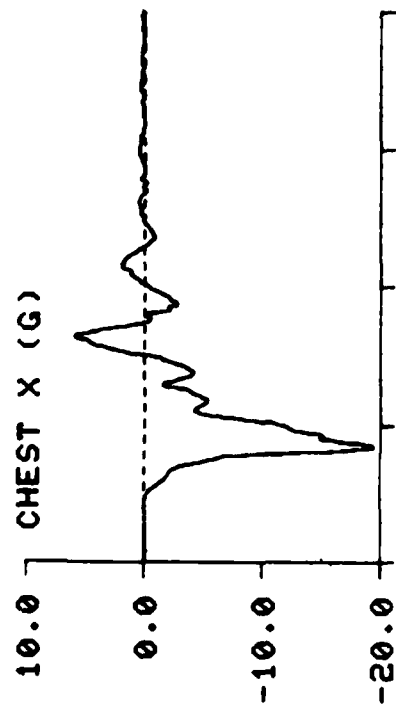




# RESTRAINT CONFIGURATION STUDY

TEST NO: 2103

SUBJ ID: R-2

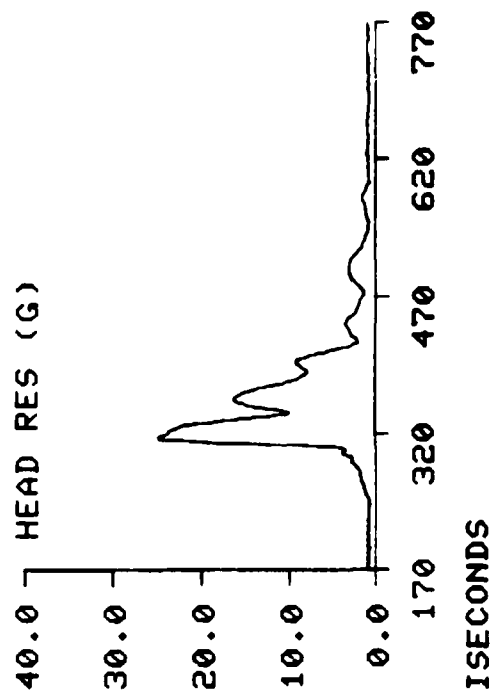
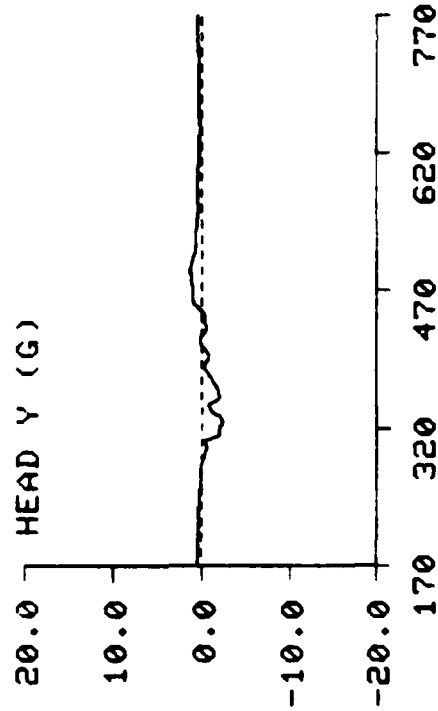
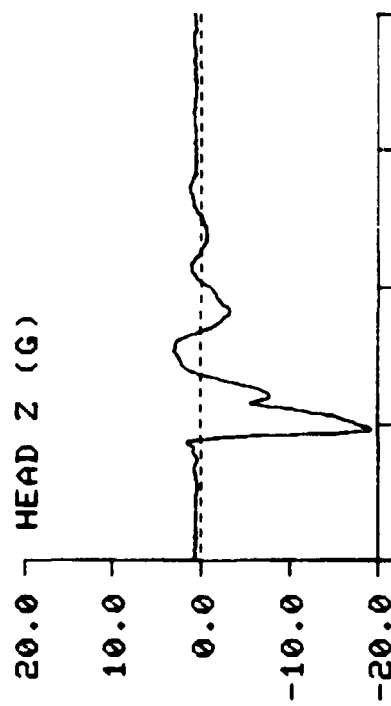
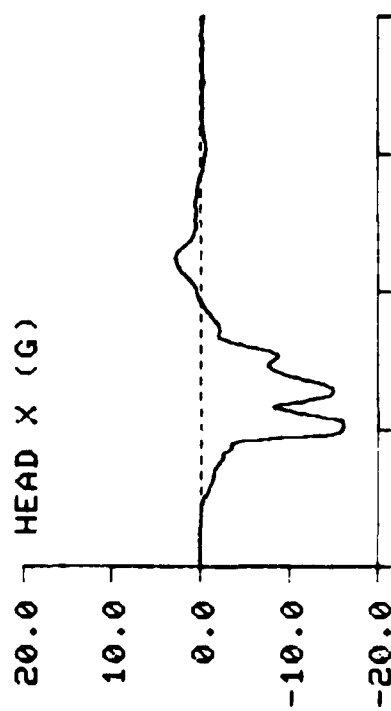


TIME IN MILLISECONDS

# RESTRAINT CONFIGURATION STUDY

TEST NO: 2103

SUBJ ID: R-2

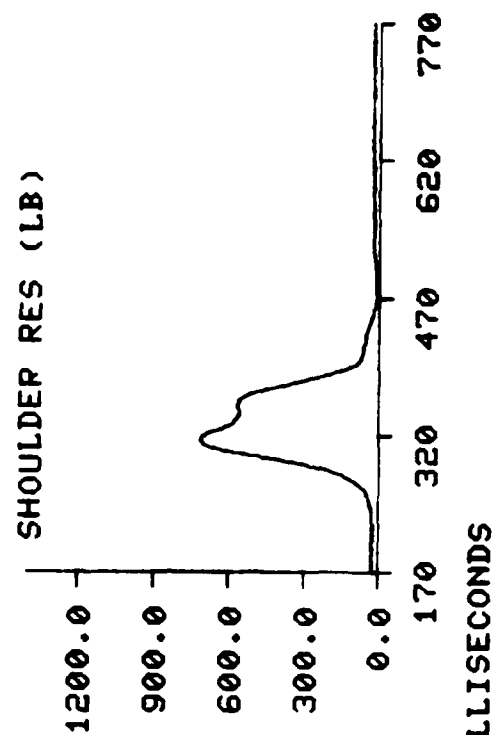
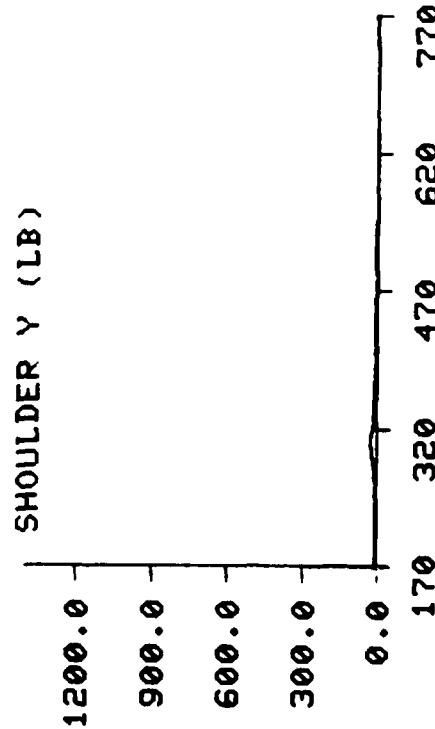
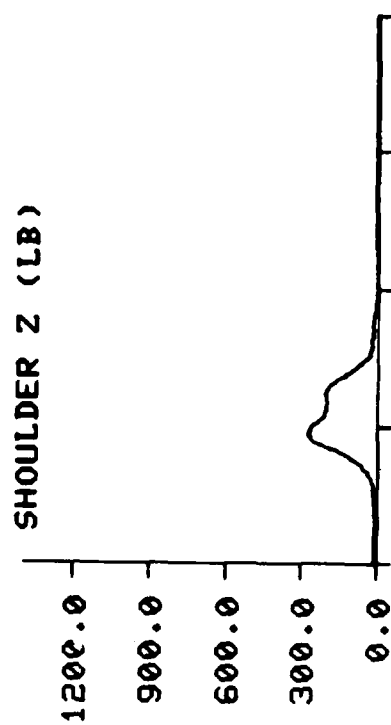
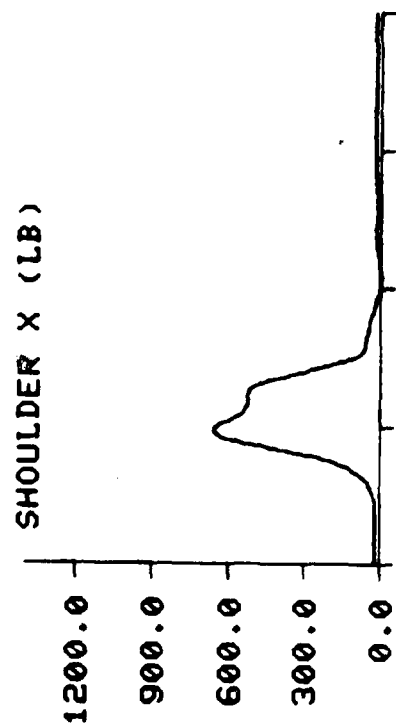


TIME IN MILLISECONDS

# RESTRAINT CONFIGURATION STUDY

TEST NO: 2103

SUBJ ID: R-2

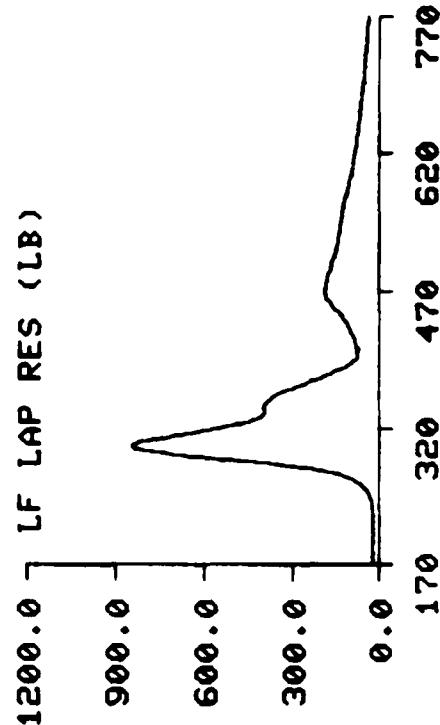
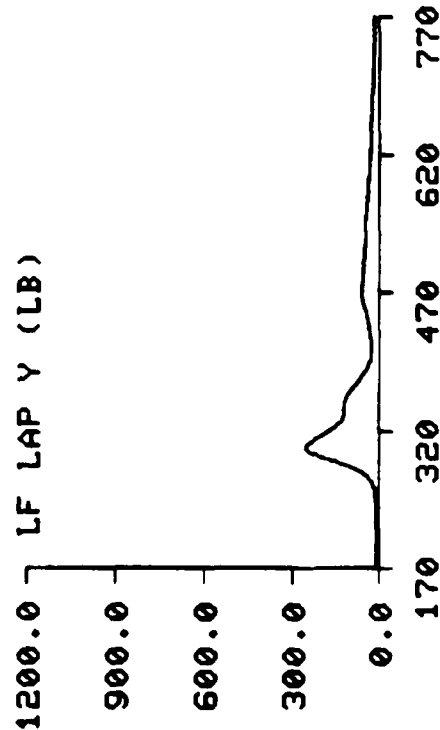
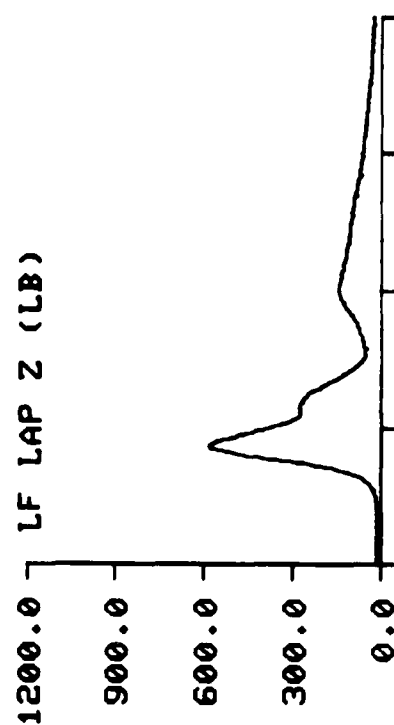
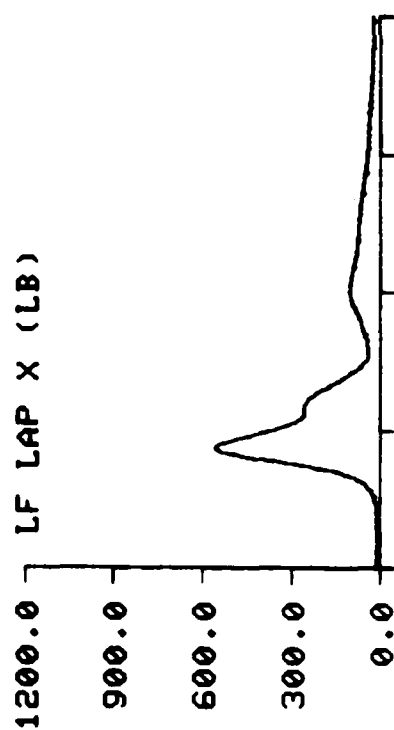


TIME IN MILLISECONDS

# RESTRAINT CONFIGURATION STUDY

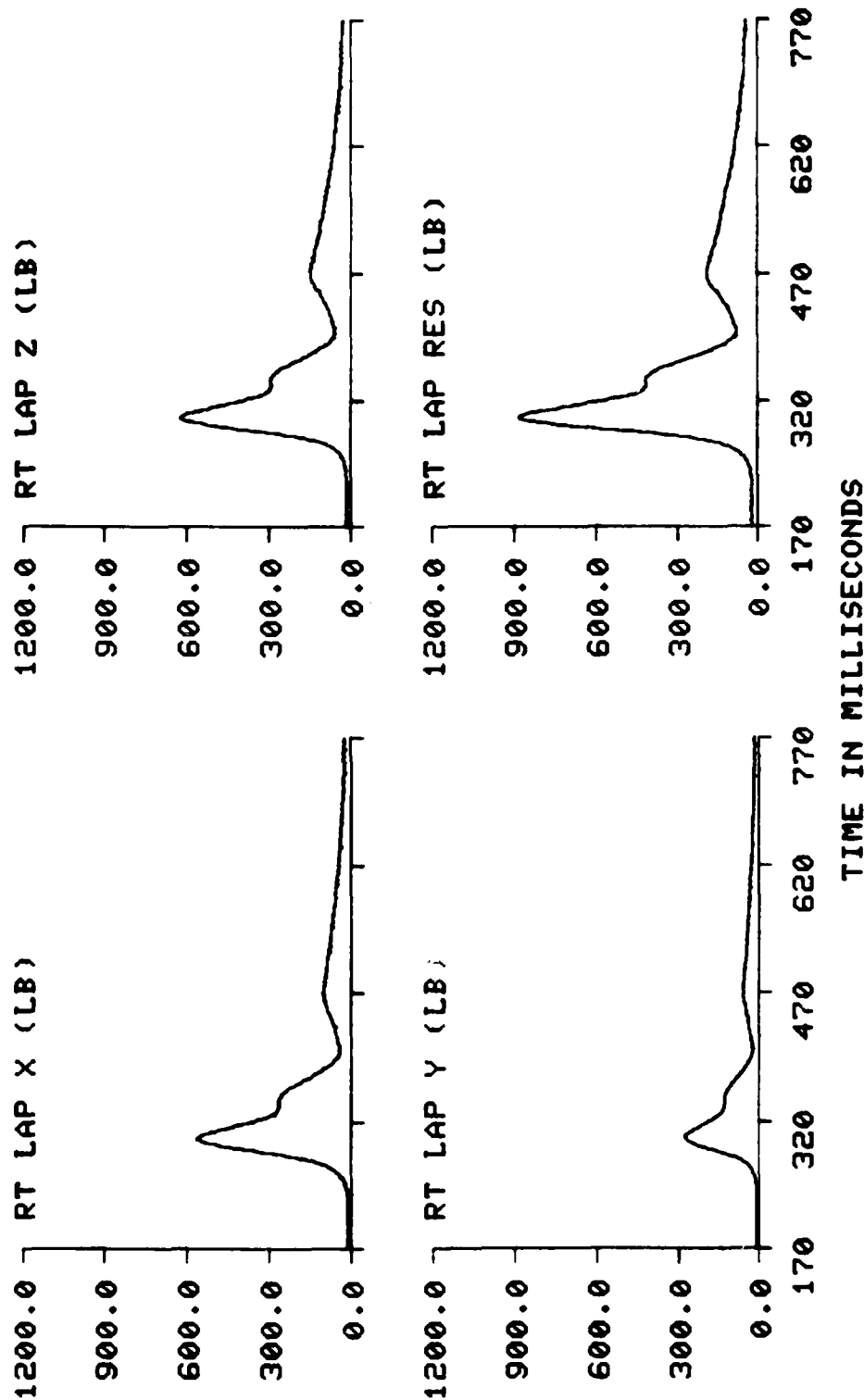
TEST NO: 2103

SUBJ ID: R-2



TIME IN MILLISECONDS

RESTRAINT CONFIGURATION STUDY      TEST NO: 2103      SUBJ ID: R-2



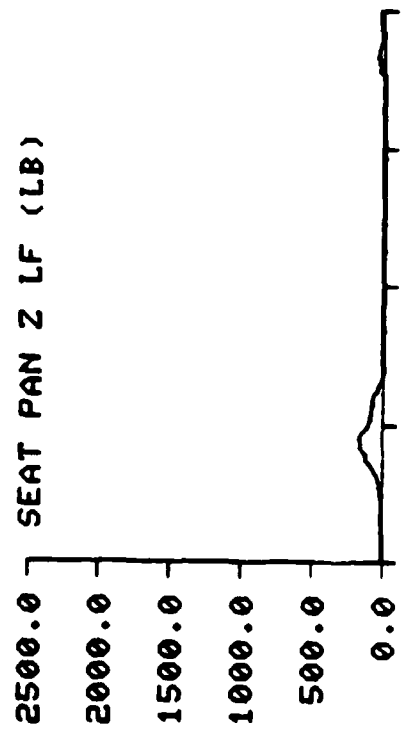
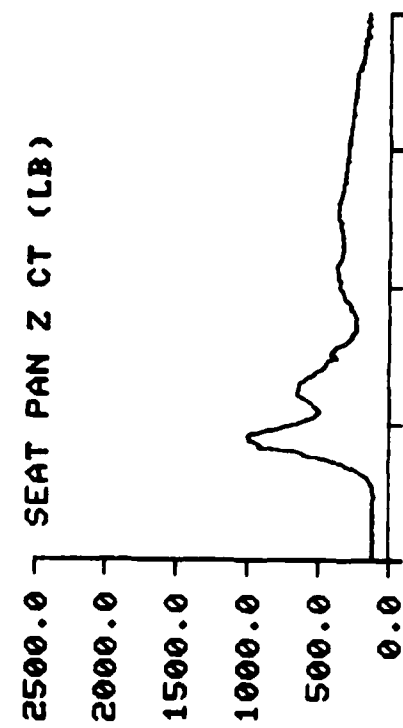
# RESTRAINT CONFIGURATION STUDY

TEST NO: 2103

SUBJ ID: R-2

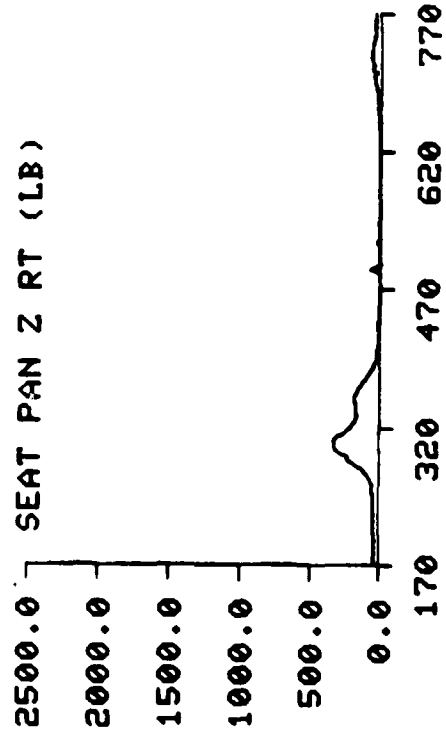
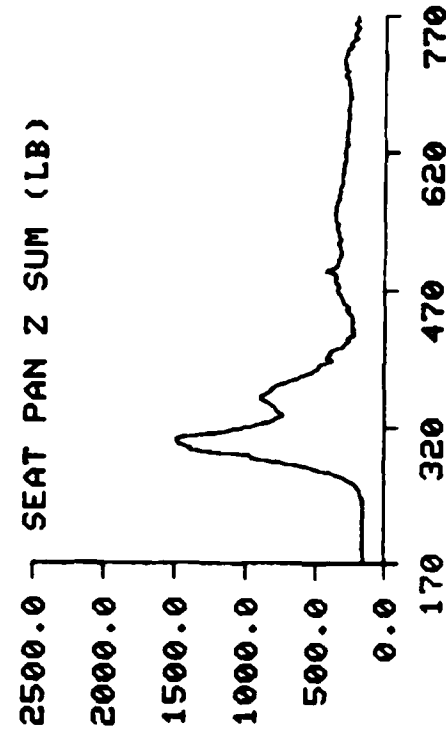
SEAT PAN Z LF (LB)

SEAT PAN Z CT (LB)



SEAT PAN Z RT (LB)

SEAT PAN Z SUM (LB)



TIME IN MILLISECONDS

VERTICAL TEST PHASE

TEST: 712

SUBJ: B-2

WT: 190.0

CELL: E

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1178		
TIME OF IMPACT START				1302		
CARRIAGE ACCELERATION (G)						
X AXIS			2.90	1302	-2.55	1310
Y AXIS			0.53	1338	-0.60	1298
Z AXIS			10.60	1338	-0.12	1256
Z AXIS (SMOOTHED)			9.91	1343	-0.02	1240
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1296	-26.25	1634
TACHOMETER (MEASURED)			-1.20	1681	-26.22	1302
SEAT ACCELERATION (G)						
X AXIS			2.22	1302	-1.93	1348
Y AXIS			1.87	1348	-0.75	1354
Z AXIS			12.59	1340	-0.69	1306
Z AXIS (SMOOTHED)			11.08	1340	-0.07	1241
CHEST ACCELERATION (G)						
X AXIS			3.82	1356	-0.88	1378
Y AXIS			1.05	1388	-2.09	1366
Z AXIS			24.60	1360	-0.75	1236
RESULTANT			24.74	1360	0.22	1303
CHEST SEVERITY INDEX			46.13			
HEAD ACCELERATION (G)						
X AXIS			3.73	1348	-1.13	1402
Y AXIS			0.63	1262	-1.77	1364
Z AXIS			12.54	1354	-0.46	1178
RESULTANT			13.14	1351	0.56	1301
HEAD SEVERITY INDEX			21.73			
SHOULDER STRAP LOADS (LB)						
X AXIS	90.29	1285	195.23	1367		
Y AXIS	1.79	594	8.19	1387		
Z AXIS	1.29	446	33.48	1373		
RESULTANT	90.62	1287	197.93	1369		
LEFT LAP LOADS (LB)						
X AXIS	83.67	1279	82.42	1370	47.54	1341
Y AXIS	19.47	1272	14.76	1381	2.38	1348
Z AXIS	85.23	1277	53.84	1373	21.44	1341
RESULTANT	120.20	1279	98.68	1370	52.56	1341
RIGHT LAP LOADS (LB)						
X AXIS	86.24	1283	79.86	1370	47.94	1340
Y AXIS	18.30	1243	11.17	1385	3.40	1354
Z AXIS	99.69	1280	59.01	1369	24.59	1340
RESULTANT	131.44	1283	99.79	1368	54.09	1340
TOTAL LAP LOAD (LB)	251.26	1279	197.92	1370	107.57	1341
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	19.60	798	47.03	1372	-26.11	1346
X AXIS (RIGHT)	22.39	441	-7.44	1250	-54.81	1309
X AXIS (SUM)	26.46	512	30.23	1372	-72.73	1346
Y AXIS (CENTER)	-21.73	919	-14.74	1579	-125.66	1353
SEAT LOADS (LB)						
Z AXIS (LEFT)	40.75	441	752.06	1371	8.72	1298
Z AXIS (RIGHT)	56.03	441	717.38	1373	14.02	1261
Z AXIS (CENTER)	177.76	1287	1627.09	1355	150.42	1170
Z AXIS (SUM)	242.51	441	2654.17	1370	189.95	1174
SEAT Z SUM / WT	1.28	441	13.97	1370	1.00	1174
RESULTANT SEAT LOAD (LB)	248.96	441	2655.29	1370	192.14	1174

VERTICAL TEST PHASE      TEST: 692      SUBJ: B-1      WT: 153.0      CELL: E

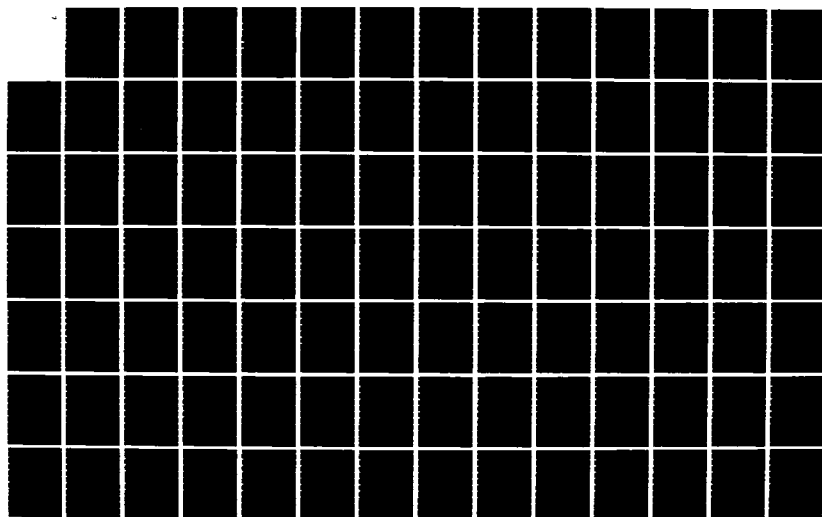
PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1226		
TIME OF IMPACT START				1354		
CARRIAGE ACCELERATION (G)						
X AXIS			3.14	1354	-2.13	1356
Y AXIS			0.40	1510	-0.42	1526
Z AXIS			10.69	1390	-0.13	1296
Z AXIS (SMOOTHED)			9.97	1401	-0.03	1311
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1346	-26.03	1704
TACHOMETER (MEASURED)			-0.70	1697	-25.94	1354
SEAT ACCELERATION (G)						
X AXIS			2.76	1354	-1.76	1356
Y AXIS			1.26	1398	-1.29	1348
Z AXIS			12.91	1394	-0.22	1322
Z AXIS (SMOOTHED)			11.08	1391	-0.18	1320
CHEST ACCELERATION (G)						
X AXIS			4.88	1412	-0.27	1356
Y AXIS			0.70	1440	-1.38	1422
Z AXIS			19.85	1412	-0.45	1340
RESULTANT			20.46	1412	0.16	1351
CHEST SEVERITY INDEX			37.98			
HEAD ACCELERATION (G)						
X AXIS			1.59	1548	-2.61	1430
Y AXIS			1.67	1410	0.21	1478
Z AXIS			15.91	1414	-0.56	1320
RESULTANT			16.02	1411	0.61	1301
HEAD SEVERITY INDEX			24.60			
SHOULDER STRAP LOADS (LB)						
X AXIS	40.44	1339	82.41	1415		
Y AXIS	9.99	900	8.06	1402		
Z AXIS	0.87	494	26.87	1412		
RESULTANT	40.54	1339	86.91	1415		
LEFT LAP LOADS (LB)						
X AXIS	123.21	1336	100.23	1420	67.84	1376
Y AXIS	25.25	1338	24.20	1417	15.95	1384
Z AXIS	68.77	1331	50.93	1418	20.55	1391
RESULTANT	143.34	1338	114.56	1417	73.07	1391
RIGHT LAP LOADS (LB)						
X AXIS	71.61	1337	72.66	1409	43.30	1378
Y AXIS	30.93	1335	29.79	1412	15.53	1391
Z AXIS	74.14	1336	45.00	1411	15.79	1391
RESULTANT	107.43	1330	89.27	1411	49.06	1392
TOTAL LAP LOAD (LB)	250.77	1339	201.60	1416	122.84	1391
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	2.06	495	15.47	1351	-39.38	1406
X AXIS (RIGHT)	2.01	604	5.52	1352	-2.21	1406
X AXIS (SUM)	-0.61	495	18.65	1351	-59.59	1406
Y AXIS (CENTER)	12.12	552	8.31	1275	-54.56	1404
SEAT LOADS (LB)						
Z AXIS (LEFT)	37.14	1339	395.50	1406	25.79	1226
Z AXIS (RIGHT)	58.57	1339	416.45	1429	36.73	1221
Z AXIS (CENTER)	117.45	493	1285.27	1407	51.78	1225
Z AXIS (SUM)	184.49	493	2073.44	1407	121.82	1225
SEAT Z SUM / WT	1.21	493	13.55	1407	0.80	1225
RESULTANT SEAT LOAD (LB)	184.67	493	2074.90	1407	122.38	1225

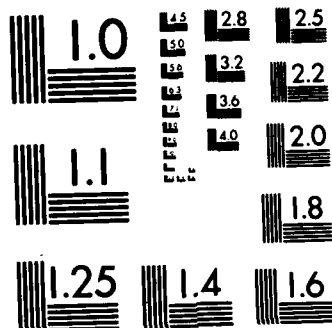


AD-A138 642

EFFECTS OF A NEGATIVE G STRAP ON RESTRAINT DYNAMICS AND 3/4  
HUMAN IMPACT RESPONSE(U) AIR FORCE AEROSPACE MEDICAL  
RESEARCH LAB WRIGHT-PATTERSON AFB. B F HEARON ET AL.  
DEC 83 AFAMRL-TR-83-083 F/G 6/17 NL

UNCLASSIFIED





MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS 1963-A

VERTICAL TEST PHASE      TEST: 668      SUBJ: B-3      WT: 181.0      CELL: E

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1246		
TIME OF IMPACT START				1371		
CARRIAGE ACCELERATION (G)						
X AXIS			3.34	1368	-2.05	1376
Y AXIS			0.21	1580	-0.64	1378
Z AXIS			10.57	1408	-0.16	1306
Z AXIS (SMOOTHED)			9.90	1419	-0.02	1277
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1366	-26.05	1679
TACHOMETER (MEASURED)			-1.18	1777	-26.17	1371
SEAT ACCELERATION (G)						
X AXIS			2.90	1368	-1.81	1376
Y AXIS			1.41	1420	-1.19	1384
Z AXIS			11.70	1410	-0.17	1304
Z AXIS (SMOOTHED)			10.99	1410	-0.11	1276
CHEST ACCELERATION (G)						
X AXIS			2.98	1438	-0.65	1466
Y AXIS			0.72	1458	-1.67	1422
Z AXIS			20.41	1434	-0.46	1302
RESULTANT			20.56	1431	0.16	1361
CHEST SEVERITY INDEX			36.20			
HEAD ACCELERATION (G)						
X AXIS			4.18	1420	-0.18	1372
Y AXIS			1.42	1422	0.17	1498
Z AXIS			12.26	1422	-0.78	1298
RESULTANT			13.01	1422	0.64	1728
HEAD SEVERITY INDEX			21.28			
SHOULDER STRAP LOADS (LB)						
X AXIS	88.81	1357	147.77	1451		
Y AXIS	17.85	1355	31.23	1441		
Z AXIS	6.59	512	41.26	1441		
RESULTANT	90.61	1357	155.60	1451		
LEFT LAP LOADS (LB)						
X AXIS	112.84	1316	104.12	1439	60.52	1410
Y AXIS	49.79	1308	40.36	1441	26.22	1415
Z AXIS	120.20	1322	75.65	1440	43.25	1409
RESULTANT	170.70	1323	133.80	1438	80.24	1410
RIGHT LAP LOADS (LB)						
X AXIS	117.59	1243	111.21	1440	70.36	1411
Y AXIS	26.01	1237	21.48	1445	9.81	1410
Z AXIS	132.55	1236	89.78	1437	48.06	1410
RESULTANT	178.16	1244	143.79	1439	85.77	1411
TOTAL LAP LOAD (LB)	342.79	1290	277.20	1439	167.06	1410
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	48.76	514	76.18	1456	-5.49	1353
X AXIS (RIGHT)	28.90	529	14.28	1369	-33.67	1424
X AXIS (SUM)	75.90	514	59.47	1456	-18.69	1353
Y AXIS (CENTER)	-0.28	1350	-0.28	1350	-87.91	1436
SEAT LOADS (LB)						
Z AXIS (LEFT)	33.82	518	587.85	1452	-16.97	1379
Z AXIS (RIGHT)	72.18	512	656.51	1442	30.61	1326
Z AXIS (CENTER)	226.37	1297	1593.98	1427	175.78	1834
Z AXIS (SUM)	274.26	1247	2359.28	1435	248.12	1326
SEAT Z SUM / WT	1.52	1247	13.03	1435	1.37	1326
RESULTANT SEAT LOAD (LB)	279.05	1247	2360.87	1435	248.19	1326

VERTICAL TEST PHASE      TEST: 719      SUBJ: C-1      WT: 171.0      CELL: E

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1234		
TIME OF IMPACT START				1362		
CARRIAGE ACCELERATION (G)						
X AXIS			1.56	1358	-1.78	1406
Y AXIS			0.74	1414	-0.71	1434
Z AXIS			10.73	1397	-0.14	1306
Z AXIS (SMOOTHED)			9.89	1401	-0.02	1302
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.00	1356	-26.05	1650
TACHOMETER (MEASURED)			-1.16	1827	-26.27	1362
SEAT ACCELERATION (G)						
X AXIS			1.20	1410	-1.73	1406
Y AXIS			1.31	1408	-1.03	1396
Z AXIS			12.45	1400	-0.15	1262
Z AXIS (SMOOTHED)			11.04	1398	-0.09	1262
CHEST ACCELERATION (G)						
X AXIS			2.18	1414	-1.52	1452
Y AXIS			0.62	1494	-1.28	1424
Z AXIS			18.20	1420	-0.76	1312
RESULTANT			18.26	1417	0.10	1350
CHEST SEVERITY INDEX			34.34			
HEAD ACCELERATION (G)						
X AXIS			6.09	1420	-0.10	1485
Y AXIS			0.80	1490	-1.20	1434
Z AXIS			11.62	1424	-0.63	1296
RESULTANT			13.16	1420	0.40	1357
HEAD SEVERITY INDEX			24.98			
SHOULDER STRAP LOADS (LB)						
X AXIS	89.93	1344	204.86	1444		
Y AXIS	5.62	1160	10.85	1452		
Z AXIS	-1.36	501	37.03	1432		
RESULTANT	90.13	1344	207.91	1444		
LEFT LAP LOADS (LB)						
X AXIS	132.87	1345	114.19	1427	81.80	1399
Y AXIS	44.36	1343	31.39	1423	21.96	1407
Z AXIS	132.99	1345	88.45	1451	56.05	1398
RESULTANT	193.16	1345	143.36	1428	102.10	1399
RIGHT LAP LOADS (LB)						
X AXIS	109.39	1342	92.80	1422	60.89	1399
Y AXIS	34.98	1345	29.15	1417	16.19	1397
Z AXIS	125.62	1344	76.60	1426	44.27	1398
RESULTANT	169.95	1344	121.76	1425	77.74	1399
TOTAL LAP LOAD (LB)	362.60	1345	264.62	1428	179.84	1399
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	25.10	508	19.00	1488	-18.78	1419
X AXIS (RIGHT)	12.30	500	14.64	1469	-19.27	1412
X AXIS (SUM)	36.18	501	28.23	1464	-35.65	1413
Y AXIS (CENTER)	-26.45	599	-32.17	1706	-111.54	1409
SEAT LOADS (LB)						
Z AXIS (LEFT)	51.84	1279	381.64	1415	34.63	1821
Z AXIS (RIGHT)	56.02	500	426.18	1413	27.18	1237
Z AXIS (CENTER)	207.42	1345	1453.28	1414	110.91	1231
Z AXIS (SUM)	302.12	1345	2255.03	1414	185.85	1231
SEAT Z SUM / WT	1.77	1345	13.19	1414	1.09	1231
RESULTANT SEAT LOAD (LB)	305.21	1345	2257.82	1414	189.57	1231

# VERTICAL TEST PHASE

TEST: 666

SUBJ: C-2

WT: 177.0

CELL: E

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1222		
TIME OF IMPACT START				1347		
CARRIAGE ACCELERATION (G)						
X AXIS			2.66	1346	-2.09	1354
Y AXIS			0.68	1344	-0.79	1352
Z AXIS			10.58	1363	-0.08	1292
Z AXIS (SMOOTHED)			9.90	1394	-0.02	1310
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION						
TACHOMETER (MEASURED)						
SEAT ACCELERATION (G)						
X AXIS			0.01	1342	-26.20	1681
Y AXIS			-1.18	1792	-26.26	1347
Z AXIS						
Z AXIS (SMOOTHED)						
CHEST ACCELERATION (G)						
X AXIS			2.15	1346	-2.06	1392
Y AXIS			1.74	1354	-1.56	1384
Z AXIS			12.17	1388	-0.29	1242
Z AXIS (SMOOTHED)			11.09	1385	-0.15	1241
CHEST ACCELERATION (G)						
X AXIS			2.97	1388	-0.62	1426
Y AXIS			-0.44	1368	-2.53	1398
Z AXIS			18.73	1398	-0.58	1230
Z AXIS (SMOOTHED)			18.94	1398	0.84	1345
CHEST ACCELERATION (G)						
X AXIS			33.84			
Y AXIS						
Z AXIS						
RESULTANT						
CHEST SEVERITY INDEX						
X AXIS			2.26	1396	-1.73	1448
Y AXIS			2.01	1416	0.88	1768
Z AXIS			11.39	1394	-0.78	1324
Z AXIS (SMOOTHED)			11.69	1394	1.05	1766
RESULTANT			21.87			
CHEST SEVERITY INDEX						
X AXIS						
Y AXIS						
Z AXIS						
RESULTANT						
HEAD ACCELERATION (G)						
X AXIS						
Y AXIS						
Z AXIS						
RESULTANT						
HEAD SEVERITY INDEX						
X AXIS						
Y AXIS						
Z AXIS						
RESULTANT						
SHOULDER STRAP LOADS (LB)						
X AXIS	42.28	1328	159.21	1424		
Y AXIS	2.76	930	14.97	1416		
Z AXIS	1.49	1148	39.87	1417		
Z AXIS (SMOOTHED)	42.34	1328	164.71	1424		
RESULTANT						
LEFT LAP LOADS (LB)						
X AXIS	64.85	1330	87.28	1414	43.68	1370
Y AXIS	20.51	1329	24.05	1413	12.26	1369
Z AXIS	65.36	1327	62.33	1448	28.92	1385
Z AXIS (SMOOTHED)	94.21	1330	109.34	1413	58.31	1370
RESULTANT						
RIGHT LAP LOADS (LB)						
X AXIS	54.84	1328	77.81	1407	40.80	1366
Y AXIS	17.39	1326	20.64	1417	8.32	1373
Z AXIS	58.53	1331	54.36	1432	20.99	1364
Z AXIS (SMOOTHED)	82.07	1331	94.04	1407	52.00	1372
RESULTANT						
TOTAL LAP LOAD (LB)	175.56	1331	201.08	1410	110.47	1370
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	4.75	1103	26.69	1475	-22.67	1414
X AXIS (RIGHT)	5.44	923	3.68	1289	-51.87	1364
X AXIS (SUM)	4.93	1103	21.87	1346	-72.11	1384
Y AXIS (CENTER)	3.70	519	3.70	1351	-43.29	1384
SEAT LOADS (LB)						
Z AXIS (LEFT)	43.98	486	453.12	1407	12.82	1234
Z AXIS (RIGHT)	45.95	486	497.50	1408	15.25	1224
Z AXIS (CENTER)	112.25	486	1347.93	1401	44.86	1231
Z AXIS (SUM)	202.18	486	2278.64	1401	80.20	1231
Z AXIS (SMOOTHED)	1.14	486	12.87	1401	0.45	1231
SEAT Z SUM / WT	202.21	486	2279.91	1401	80.21	1231
RESULTANT SEAT LOAD (LB)						

## VERTICAL TEST PHASE

TEST: 646

SUBJ: H-6

WT: 188.0

CELL: E

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK						
TIME OF IMPACT START				1184		
CARRIAGE ACCELERATION (G)				1298		
X AXIS			1.86	1348	-2.29	1356
Y AXIS			0.40	1428	-0.50	1310
Z AXIS			10.65	1346	-0.10	1184
Z AXIS (SMOOTHED)			9.94	1358	-0.03	1180
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1904	-26.23	1650
TACHOMETER (MEASURED)			-1.16	1727	-26.03	1298
SEAT ACCELERATION (G)						
X AXIS			1.62	1308	-1.94	1352
Y AXIS			1.77	1358	-1.93	1324
Z AXIS			12.76	1350	-0.25	1220
Z AXIS (SMOOTHED)			11.12	1348	-0.20	1219
CHEST ACCELERATION (G)						
X AXIS			2.99	1360	-1.74	1390
Y AXIS			0.60	1446	-2.66	1396
Z AXIS			21.33	1370	-0.61	1290
Z AXIS (SMOOTHED)			21.53	1370	0.08	1481
RESULTANT			43.52			
CHEST SEVERITY INDEX						
HEAD ACCELERATION (G)						
X AXIS			5.44	1366	-0.21	1462
Y AXIS			1.70	1414	-0.22	1364
Z AXIS			11.62	1364	-0.95	1264
Z AXIS (SMOOTHED)			12.79	1364	1.03	1599
RESULTANT			22.37			
HEAD SEVERITY INDEX						
SHOULDER STRAP LOADS (LB)						
X AXIS	93.25	1294	239.16	1398		
Y AXIS	6.08	1198	16.56	1389		
Z AXIS	8.54	450	71.70	1391		
Z AXIS (SMOOTHED)	93.37	1294	249.11	1398		
RESULTANT						
LEFT LAP LOADS (LB)						
X AXIS	78.18	1292	131.75	1384	54.51	1329
Y AXIS	26.49	1293	38.86	1389	16.47	1355
Z AXIS	77.49	1291	94.70	1383	27.88	1346
Z AXIS (SMOOTHED)	112.40	1294	165.46	1383	64.63	1346
RESULTANT						
RIGHT LAP LOADS (LB)						
X AXIS	75.23	1294	130.12	1382	52.26	1329
Y AXIS	22.11	1286	31.19	1381	11.10	1348
Z AXIS	77.58	1293	100.53	1383	27.51	1347
Z AXIS (SMOOTHED)	110.31	1295	166.50	1382	62.44	1347
RESULTANT						
TOTAL LAP LOAD (LB)	222.15	1295	331.70	1382	129.25	1348
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	7.23	613	19.42	1440	-18.98	1371
X AXIS (RIGHT)	9.49	791	16.35	1459	-61.43	1364
X AXIS (SUM)	7.20	613	32.11	1459	-74.34	1363
Y AXIS (CENTER)	4.53	567	0.72	1180	-38.01	1347
SEAT LOADS (LB)						
Z AXIS (LEFT)	47.78	449	423.15	1377	13.39	1302
Z AXIS (RIGHT)	51.12	449	494.03	1378	13.75	1285
Z AXIS (CENTER)	131.24	449	1440.85	1364	88.86	1181
Z AXIS (SUM)	212.86	449	2242.47	1369	134.07	1182
SEAT Z SUM / WT	1.13	449	11.93	1369	0.71	1182
RESULTANT SEAT LOAD (LB)	212.92	449	2243.68	1369		
					134.30	1182

VERTICAL TEST PHASE      TEST: 685      SUBJ: J-4      WT: 187.0      CELL: E

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1220		
TIME OF IMPACT START				1347		
CARRIAGE ACCELERATION (G)						
X AXIS			1.46	1344	-1.94	1390
Y AXIS			1.33	1396	-0.75	1418
Z AXIS			10.73	1383	-0.07	1258
Z AXIS (SMOOTHED)			9.94	1387	-0.03	1281
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1338	-25.99	1674
TACHOMETER (MEASURED)			-1.20	1711	-26.25	1347
SEAT ACCELERATION (G)						
X AXIS			1.50	1396	-1.96	1392
Y AXIS			1.53	1396	-1.02	1356
Z AXIS			12.20	1384	-0.26	1230
Z AXIS (SMOOTHED)			10.99	1385	-0.14	1220
CHEST ACCELERATION (G)						
X AXIS			2.11	1400	-1.86	1422
Y AXIS			0.39	1428	-1.69	1354
Z AXIS			19.01	1412	-1.33	1498
RESULTANT			19.05	1409	0.33	1484
CHEST SEVERITY INDEX			35.72			
HEAD ACCELERATION (G)						
X AXIS			4.11	1402	-0.49	1504
Y AXIS			2.18	1468	-0.39	1570
Z AXIS			12.73	1406	-0.46	1484
RESULTANT			13.33	1405	0.52	1342
HEAD SEVERITY INDEX			26.48			
SHOULDER STRAP LOADS (LB)						
X AXIS	58.91	720	154.85	1435		
Y AXIS	4.48	628	17.86	1446		
Z AXIS	-0.72	486	19.10	1424		
RESULTANT	59.66	740	156.34	1435		
LEFT LAP LOADS (LB)						
X AXIS	97.89	1330	107.86	1417	55.54	1384
Y AXIS	41.79	1329	40.02	1417	21.75	1395
Z AXIS	104.73	1327	80.43	1417	32.84	1384
RESULTANT	148.45	1330	140.37	1417	68.88	1385
RIGHT LAP LOADS (LB)						
X AXIS	88.31	1330	107.45	1420	50.01	1367
Y AXIS	18.08	1318	14.19	1421	5.77	1385
Z AXIS	104.91	1329	89.26	1419	32.94	1385
RESULTANT	138.23	1330	140.41	1419	61.85	1384
TOTAL LAP LOAD (LB)	286.68	1330	277.55	1418	130.94	1384
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	25.49	1311	46.82	1384	12.69	1414
X AXIS (RIGHT)	32.67	487	12.20	1492	-45.70	1408
X AXIS (SUM)	38.44	530	43.49	1470	-28.91	1414
Y AXIS (CENTER)	-22.45	1283	-22.45	1283	-63.73	1411
SEAT LOADS (LB)						
Z AXIS (LEFT)	88.92	1329	559.12	1404	48.77	1674
Z AXIS (RIGHT)	90.34	1327	700.93	1401	49.24	1743
Z AXIS (CENTER)	167.90	673	1298.64	1403	78.87	1234
Z AXIS (SUM)	283.01	1329	2547.80	1403	199.63	1223
SEAT Z SUM / WT	1.51	1329	13.62	1403	1.06	1223
RESULTANT SEAT LOAD (LB)	285.19	1329	2548.56	1403	202.34	1223

VERTICAL TEST PHASE      TEST: 693      SUBJ: K-1      WT: 181.0      CELL: E

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1254		
TIME OF IMPACT START				1376		
CARRIAGE ACCELERATION (G)						
X AXIS			3.38	1376	-2.17	1384
Y AXIS			0.53	1536	-0.61	1544
Z AXIS			10.72	1415	-0.15	1312
Z AXIS (SMOOTHED)			9.83	1427	-0.04	1313
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1372	-26.08	1716
TACHOMETER (MEASURED)			-1.18	1734	-26.36	1376
SEAT ACCELERATION (G)						
X AXIS			2.88	1378	-1.71	1422
Y AXIS			1.36	1422	-1.12	1392
Z AXIS			12.43	1416	-0.16	1314
Z AXIS (SMOOTHED)			10.93	1416	-0.14	1312
CHEST ACCELERATION (G)						
X AXIS			9.73	1450	-0.18	1472
Y AXIS			1.07	1512	-1.65	1470
Z AXIS			19.86	1442	-0.44	1354
RESULTANT			20.22	1442	0.14	1308
CHEST SEVERITY INDEX			40.61			
HEAD ACCELERATION (G)						
X AXIS			2.00	1432	-2.07	1478
Y AXIS			1.18	1750	-3.55	1612
Z AXIS			13.87	1440	-1.55	1750
RESULTANT			13.99	1435	0.32	1626
HEAD SEVERITY INDEX			24.40			
SHOULDER STRAP LOADS (LB)						
X AXIS	67.90	1363	131.85	1462		
Y AXIS	4.56	1339	4.56	1339		
Z AXIS	1.46	518	36.13	1450		
RESULTANT	68.25	1364	165.96	1462		
LEFT LAP LOADS (LB)						
X AXIS	86.01	1304	78.53	1446	33.69	1417
Y AXIS	26.03	1306	19.54	1457	8.35	1421
Z AXIS	89.32	1318	49.83	1450	11.36	1416
RESULTANT	125.99	1316	93.43	1446	37.30	1417
RIGHT LAP LOADS (LB)						
X AXIS	78.58	1276	60.71	1454	22.41	1418
Y AXIS	22.71	1292	14.93	1450	3.91	1416
Z AXIS	81.98	1285	37.13	1468	-0.42	1416
RESULTANT	115.68	1285	71.03	1447	23.02	1418
TOTAL LAP LOAD (LB)	239.94	1316	163.00	1446	60.82	1418
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	5.19	1002	21.04	1375	-27.72	1446
X AXIS (RIGHT)	4.23	668	12.42	1541	-43.72	1431
Y AXIS (SUM)	5.82	660	32.26	1376	-61.32	1441
Y AXIS (CENTER)	1.12	993	-1.42	1745	-44.60	1429
SEAT LOADS (LB)						
Z AXIS (LEFT)	72.05	1285	508.45	1436	23.10	1707
Z AXIS (RIGHT)	71.45	518	480.08	1441	37.16	1738
Z AXIS (CENTER)	125.79	1364	1455.80	1433	81.50	1251
Z AXIS (SUM)	238.22	1300	2435.98	1433	202.92	1252
SEAT Z SUM / WT	1.32	1300	13.46	1433	1.12	1252
RESULTANT SEAT LOAD (LB)	238.30	1300	2436.76	1433	202.99	1252



VERTICAL TEST PHASE      TEST: 670      SUBJ: M13      WT: 173.0      CELL: E

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1186		
TIME OF IMPACT START				1306		
CARRIAGE ACCELERATION (G)						
X AXIS			1.55	1348	-1.81	1356
Y AXIS			0.19	1360	-0.85	1376
Z AXIS			10.59	1346	-0.11	1184
Z AXIS (SMOOTHED)			9.90	1351	-0.03	1180
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1304	-25.99	1649
TACHOMETER (MEASURED)			-1.18	1684	-26.23	1306
SEAT ACCELERATION (G)						
X AXIS			1.39	1302	-1.99	1352
Y AXIS			1.19	1356	-0.34	1318
Z AXIS			11.53	1350	-0.18	1218
Z AXIS (SMOOTHED)			10.79	1349	-0.13	1218
CHEST ACCELERATION (G)						
X AXIS			0.78	1426	-2.69	1396
Y AXIS			0.56	1382	-1.80	1346
Z AXIS			20.15	1366	-0.68	1254
RESULTANT			20.15	1363	0.48	1468
CHEST SEVERITY INDEX			40.06			
HEAD ACCELERATION (G)						
X AXIS			3.34	1364	-0.80	1386
Y AXIS			1.74	1412	-0.39	1384
Z AXIS			15.08	1368	-1.05	1222
RESULTANT			15.43	1388	1.11	1589
HEAD SEVERITY INDEX			25.64			
SHOULDER STRAP LOADS (LB)						
X AXIS	34.24	1293	115.19	1382		
Y AXIS	3.32	504	7.97	1387		
Z AXIS	-0.77	449	22.76	1365		
RESULTANT	34.67	1293	117.08	1384		
LEFT LAP LOADS (LB)						
X AXIS	84.98	1287	78.73	1373	47.59	1339
Y AXIS	31.58	1290	28.63	1378	19.20	1349
Z AXIS	76.99	1275	46.61	1377	18.26	1347
RESULTANT	118.11	1291	94.36	1378	55.24	1348
RIGHT LAP LOADS (LB)						
X AXIS	85.55	1201	86.83	1371	43.43	1337
Y AXIS	25.60	1228	21.71	1374	11.34	1342
Z AXIS	83.02	1191	53.82	1374	17.31	1347
RESULTANT	121.09	1205	102.57	1375	49.79	1348
TOTAL LAP LOAD (LB)	233.87	1223	195.92	1375	105.03	1348
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	31.81	451	39.74	1404	3.78	1353
X AXIS (RIGHT)	39.52	449	23.73	1198	-9.75	1361
X AXIS (SUM)	70.72	449	53.53	1404	1.19	1353
Y AXIS (CENTER)	43.31	449	27.43	1623	-1.14	1356
SEAT LOADS (LB)						
Z AXIS (LEFT)	85.39	449	499.76	1366	45.18	1237
Z AXIS (RIGHT)	107.24	450	527.12	1371	47.26	1608
Z AXIS (CENTER)	74.00	449	1376.88	1365	17.41	1192
Z AXIS (SUM)	266.32	449	2396.51	1365	162.55	1203
SEAT Z SUM / WT	1.54	449	13.85	1365	0.94	1203
RESULTANT SEAT LOAD (LB)	278.93	449	2396.52	1365	169.59	1195

VERTICAL TEST PHASE

TEST: 721

SUBJ: P-3

WT: 208.0

CELL: E

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1242		
TIME OF IMPACT START				1367		
CARRIAGE ACCELERATION (G)						
X AXIS			1.77	1364	-1.54	1414
Y AXIS			0.39	1580	-0.50	1370
Z AXIS			10.51	1405	-0.12	1274
Z AXIS (SMOOTHED)			9.82	1417	-0.03	1275
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.02	1359	-26.27	1707
TACHOMETER (MEASURED)			-1.20	1718	-26.31	1367
SEAT ACCELERATION (G)						
X AXIS			1.50	1364	-1.54	1414
Y AXIS			0.99	1432	-0.75	1466
Z AXIS			11.53	1408	-0.16	1316
Z AXIS (SMOOTHED)			10.62	1406	-0.12	1240
CHEST ACCELERATION (G)						
X AXIS			6.02	1424	-0.47	1482
Y AXIS			0.13	1464	-1.82	1440
Z AXIS			16.35	1428	-1.51	1526
RESULTANT			17.38	1425	0.53	1535
CHEST SEVERITY INDEX			32.68			
HEAD ACCELERATION (G)						
X AXIS			1.58	1504	-2.82	1468
Y AXIS			1.03	1500	-0.37	1440
Z AXIS			12.21	1422	-0.66	1520
RESULTANT			12.28	1416	0.34	1532
HEAD SEVERITY INDEX			23.83			
SHOULDER STRAP LOADS (LB)						
X AXIS	74.34	1350	223.25	1459		
Y AXIS	-1.40	546	0.93	1839		
Z AXIS	-7.18	521	3.96	1418		
RESULTANT	78.10	1354	223.43	1461		
LEFT LAP LOADS (LB)						
X AXIS	128.19	1353	173.04	1435	100.78	1394
Y AXIS	31.28	1345	38.36	1439	21.27	1405
Z AXIS	124.87	1354	141.07	1433	77.29	1405
RESULTANT	180.98	1353	225.80	1432	132.71	1394
RIGHT LAP LOADS (LB)						
X AXIS	118.25	1354	153.99	1435	91.45	1400
Y AXIS	37.03	1353	44.81	1434	27.31	1390
Z AXIS	130.29	1352	135.51	1434	78.14	1405
RESULTANT	179.55	1354	209.96	1434	127.40	1400
TOTAL LAP LOAD (LB)	360.34	1354	435.67	1434	261.73	1400
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	1.40	1324	20.90	1489	-42.48	1411
X AXIS (RIGHT)	2.73	893	3.31	1500	-27.68	1420
X AXIS (SUM)	-1.26	590	21.85	1492	-68.36	1421
Y AXIS (CENTER)	2.60	561	1.97	1314	-74.66	1420
SEAT LOADS (LB)						
Z AXIS (LEFT)	113.46	1352	645.74	1433	53.63	1249
Z AXIS (RIGHT)	66.40	1344	535.32	1430	32.16	1247
Z AXIS (CENTER)	160.70	1354	1583.98	1421	74.32	1242
Z AXIS (SUM)	333.25	1353	2671.02	1430	163.26	1240
SEAT Z SUM / WT	1.60	1353	12.84	1430	0.78	1240
RESULTANT SEAT LOAD (LB)	333.59	1353	2672.54	1430	163.34	1240

VERTICAL TEST PHASE		TEST: 702	SUBJ: A-2	WT: 146.0	CELL: E	
PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1232		
TIME OF IMPACT START				1353		
CARRIAGE ACCELERATION (G)						
X AXIS			1.88	1356	-1.86	1404
Y AXIS			0.70	1398	-0.67	1384
Z AXIS			10.53	1394	-0.12	1268
Z AXIS (SMOOTHED)			9.94	1405	-0.03	1266
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.02	1347	-25.96	1685
TACHOMETER (MEASURED)			-1.12	1781	-26.36	1353
SEAT ACCELERATION (G)						
X AXIS			1.71	1356	-1.94	1400
Y AXIS			1.54	1406	-1.55	1352
Z AXIS			11.60	1408	-0.21	1314
Z AXIS (SMOOTHED)			10.74	1408	-0.17	1254
CHEST ACCELERATION (G)						
X AXIS			2.01	1406	-0.64	1450
Y AXIS			0.05	1454	-1.92	1412
Z AXIS			20.03	1414	-0.57	1266
RESULTANT			20.15	1411	0.54	1354
CHEST SEVERITY INDEX			34.78			
HEAD ACCELERATION (G)						
X AXIS			1.92	1406	-0.81	1446
Y AXIS			1.92	1506	0.09	1440
Z AXIS			12.24	1424	-0.95	1294
RESULTANT			12.29	1424	0.86	1648
HEAD SEVERITY INDEX			22.22			
SHOULDER STRAP LOADS (LB)						
X AXIS	54.11	1338	123.07	1434		
Y AXIS	2.98	1205	19.27	1435		
Z AXIS	4.88	1268	45.74	1413		
RESULTANT	54.24	1338	131.87	1436		
LEFT LAP LOADS (LB)						
X AXIS	87.38	1334	111.05	1419	50.01	1385
Y AXIS	32.95	1333	36.48	1420	17.62	1385
Z AXIS	86.40	1331	74.25	1420	26.67	1393
RESULTANT	126.22	1331	137.48	1420	61.13	1386
RIGHT LAP LOADS (LB)						
X AXIS	72.12	1327	101.48	1421	41.48	1384
Y AXIS	28.81	1321	37.24	1421	13.26	1394
Z AXIS	73.60	1325	70.47	1422	19.36	1394
RESULTANT	106.82	1327	129.04	1421	50.65	1395
TOTAL LAP LOAD (LB)	230.43	1331	265.82	1421	111.68	1386
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	13.03	1333	41.06	1396	3.89	1250
X AXIS (RIGHT)	2.01	589	3.18	1465	-20.60	1424
X AXIS (SUM)	7.32	1303	30.80	1396	-14.47	1424
Y AXIS (CENTER)	14.52	512	8.17	1629	-27.39	1408
SEAT LOADS (LB)						
Z AXIS (LEFT)	34.75	496	388.25	1408	13.60	1352
Z AXIS (RIGHT)	44.96	1332	479.89	1409	21.26	1242
Z AXIS (CENTER)	156.66	1341	1205.23	1412	99.45	1236
Z AXIS (SUM)	219.72	1341	2055.62	1410	146.76	1232
SEAT Z SUM / WT	1.50	1341	14.08	1410	1.01	1232
RESULTANT SEAT LOAD (LB)	219.83	1341	2055.78	1410	146.93	1232

VERTICAL TEST PHASE      TEST: 691      SUBJ: R-3      WT: 156.0      CELL: E

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1254		
TIME OF IMPACT START				1383		
CARRIAGE ACCELERATION (G)						
X AXIS			1.69	1376	-1.94	1422
Y AXIS			0.44	1418	-0.60	1446
Z AXIS			10.74	1416	-0.11	1278
Z AXIS (SMOOTHED)			10.00	1427	-0.04	1265
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1373	-26.13	1728
TACHOMETER (MEASURED)			-1.19	1754	-26.21	1383
SEAT ACCELERATION (G)						
X AXIS			1.48	1376	-1.80	1422
Y AXIS			1.72	1426	-0.67	1418
Z AXIS			12.41	1420	-0.34	1270
Z AXIS (SMOOTHED)			11.01	1417	-0.20	1266
CHEST ACCELERATION (G)						
X AXIS			3.54	1442	-0.61	1468
Y AXIS			0.86	1486	-2.00	1442
Z AXIS			19.94	1440	-0.51	1260
RESULTANT			20.32	1440	0.27	1298
CHEST SEVERITY INDEX			38.84			
HEAD ACCELERATION (G)						
X AXIS			1.31	1428	-2.68	1458
Y AXIS			1.00	1508	-0.63	1464
Z AXIS			14.22	1438	-0.61	1370
RESULTANT			14.23	1438	0.34	1338
HEAD SEVERITY INDEX			22.69			
SHOULDER STRAP LOADS (LB)						
X AXIS	45.95	817	165.88	1452		
Y AXIS	7.90	1160	22.44	1449		
Z AXIS	7.97	519	58.75	1450		
RESULTANT	46.62	827	176.46	1452		
LEFT LAP LOADS (LB)						
X AXIS	69.91	1362	66.18	1437	40.01	1418
Y AXIS	38.30	1363	30.64	1440	24.15	1421
Z AXIS	110.66	1361	71.18	1436	51.94	1416
RESULTANT	135.40	1362	100.85	1434	70.50	1418
RIGHT LAP LOADS (LB)						
X AXIS	99.13	1362	104.24	1437	76.15	1418
Y AXIS	38.72	1355	36.77	1437	25.75	1417
Z AXIS	106.76	1363	77.56	1438	51.48	1417
RESULTANT	149.91	1363	134.43	1437	96.49	1417
TOTAL LAP LOAD (LB)	285.08	1362	234.94	1437	167.28	1418
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	7.37	1334	18.95	1375	-12.74	1445
X AXIS (RIGHT)	1.19	1320	3.53	1376	-35.06	1433
X AXIS (SUM)	6.23	1334	21.88	1376	-40.74	1441
Y AXIS (CENTER)	2.74	577	-0.43	1251	-69.01	1430
SEAT LOADS (LB)						
Z AXIS (LEFT)	57.27	1361	343.31	1436	21.94	1713
Z AXIS (RIGHT)	84.64	1334	426.30	1432	27.34	1820
Z AXIS (CENTER)	131.75	1363	1370.52	1435	81.29	1257
Z AXIS (SUM)	266.57	1364	2124.72	1434	167.54	1257
SEAT Z SUM / WT	1.71	1364	13.62	1434	1.07	1253
RESULTANT SEAT LOAD (LB)	266.67	1364	2126.03	1434	167.57	1253

VERTICAL TEST PHASE      TEST: 711      SUBJ: S-6      WT: 117.0      CELL: E

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1246		
TIME OF IMPACT START				1375		
CARRIAGE ACCELERATION (G)						
X AXIS			1.70	1412	-1.72	1420
Y AXIS			0.42	1516	-0.71	1358
Z AXIS			10.72	1410	-0.12	1274
Z AXIS (SMOOTHED)			10.06	1415	-0.03	1285
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.02	1364	-26.16	1692
TACHOMETER (MEASURED)			-1.17	1621	-26.25	1375
SEAT ACCELERATION (G)						
X AXIS			1.36	1412	-1.60	1416
Y AXIS			1.50	1422	-0.65	1370
Z AXIS			11.55	1414	-0.09	1348
Z AXIS (SMOOTHED)			10.90	1412	-0.06	1275
CHEST ACCELERATION (G)						
X AXIS			0.58	1548	-2.40	1432
Y AXIS			0.09	1558	-2.45	1428
Z AXIS			15.84	1432	-0.75	1292
RESULTANT			16.18	1428	0.26	1371
CHEST SEVERITY INDEX			30.07			
HEAD ACCELERATION (G)						
X AXIS			2.74	1422	-1.17	1550
Y AXIS			1.27	1754	-0.50	1434
Z AXIS			10.97	1434	-1.59	1754
RESULTANT			11.28	1431	0.42	1771
HEAD SEVERITY INDEX			19.35			
SHOULDER STRAP LOADS (LB)						
X AXIS	39.20	1227	130.15	1449		
Y AXIS	2.55	1348	5.46	1545		
Z AXIS	10.90	1204	70.34	1435		
RESULTANT	40.37	1244	147.36	1450		
LEFT LAP LOADS (LB)						
X AXIS	53.72	1348	81.13	1443	36.28	1395
Y AXIS	26.97	1351	36.40	1444	18.72	1393
Z AXIS	57.77	1349	56.76	1442	20.31	1411
RESULTANT	82.67	1353	104.74	1443	51.20	1412
RIGHT LAP LOADS (LB)						
X AXIS	43.27	1350	73.91	1446	29.23	1399
Y AXIS	14.52	1301	22.29	1444	8.04	1391
Z AXIS	50.11	1295	56.37	1444	12.56	1411
RESULTANT	66.87	1352	95.58	1444	35.28	1412
TOTAL LAP LOAD (LB)	148.73	1353	199.97	1442	86.48	1412
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	10.85	1015	48.63	1498	-1.95	1366
X AXIS (RIGHT)	18.73	1205	19.31	1371	-15.19	1426
X AXIS (SUM)	23.48	1205	61.51	1498	-12.93	1417
Y AXIS (CENTER)	8.70	1012	8.70	1521	-25.59	1409
SEAT LOADS (LB)						
Z AXIS (LEFT)	24.01	512	235.26	1433	1.74	1284
Z AXIS (RIGHT)	26.03	512	281.31	1435	-8.49	1374
Z AXIS (CENTER)	95.99	1357	1073.95	1427	73.01	1242
Z AXIS (SUM)	126.98	512	1525.85	1429	81.08	1284
SEAT Z SUM / WT	1.10	512	13.04	1429	0.69	1284
RESULTANT SEAT LOAD (LB)	128.98	512	1525.96	1429	82.87	1284

VERTICAL TEST PHASE      TEST: /22      SUBJ: T-1      WT: 169.0      CELL: E

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1232		
TIME OF IMPACT START				1358		
CARRIAGE ACCELERATION (G)						
X AXIS			2.06	1396	-1.90	1404
Y AXIS			0.57	1356	-0.82	1362
Z AXIS			10.59	1394	-0.08	1272
Z AXIS (SMOOTHED)			9.93	1399	-0.03	1269
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1352	-26.09	1680
TACHOMETER (MEASURED)			-1.20	1708	-26.28	1358
SEAT ACCELERATION (G)						
X AXIS			1.64	1356	-1.82	1400
Y AXIS			2.95	1364	-1.35	1374
Z AXIS			12.21	1398	-0.21	1230
Z AXIS (SMOOTHED)			10.94	1396	-0.15	1230
CHEST ACCELERATION (G)						
X AXIS			1.03	1474	-1.19	1444
Y AXIS			-0.11	1356	-2.11	1416
Z AXIS			16.94	1412	-0.57	1340
RESULTANT			17.07	1412	0.27	1356
CHEST SEVERITY INDEX			31.18			
HEAD ACCELERATION (G)						
X AXIS			4.61	1410	-0.45	1262
Y AXIS			1.23	1626	-0.50	1426
Z AXIS			12.34	1418	-0.54	1338
RESULTANT			12.99	1413	0.53	1283
HEAD SEVERITY INDEX			22.30			
SHOULDER STRAP LOADS (LB)						
X AXIS	107.00	1341	214.94	1425		
Y AXIS	17.90	1228	28.38	1413		
Z AXIS	4.90	1254	53.20	1424		
RESULTANT	108.36	1341	222.87	1425		
LEFT LAP LOADS (LB)						
X AXIS	135.69	1288	108.28	1420	82.12	1395
Y AXIS	38.59	1301	26.81	1423	19.14	1397
Z AXIS	130.83	1293	75.14	1420	48.82	1395
RESULTANT	192.28	1293	134.16	1420	97.67	1395
RIGHT LAP LOADS (LB)						
X AXIS	114.55	1328	92.85	1425	66.04	1396
Y AXIS	30.02	1320	23.54	1429	14.46	1396
Z AXIS	111.44	1308	63.46	1419	38.43	1395
RESULTANT	162.37	1330	114.52	1420	78.82	1396
TOTAL LAP LOAD (LB)	352.06	1308	248.68	1420	176.62	1396
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	0.73	965	40.35	1405	-9.02	1363
X AXIS (RIGHT)	1.79	568	8.22	1493	-50.26	1410
X AXIS (SUM)	0.11	581	27.46	1486	-27.66	1401
Y AXIS (CENTER)	2.78	574	-2.30	1796	-53.73	1396
SEAT LOADS (LB)						
Z AXIS (LEFT)	33.25	985	324.54	1416	13.20	1314
Z AXIS (RIGHT)	37.36	496	490.24	1422	19.06	1244
Z AXIS (CENTER)	223.42	1342	1612.13	1411	153.19	1827
Z AXIS (SUM)	266.00	1342	2339.16	1413	243.56	1812
SEAT Z SUM / WT	1.57	1342	13.84	1413	1.44	1812
RESULTANT SEAT LOAD (LB)	266.36	1342	2339.45	1413	243.74	1812

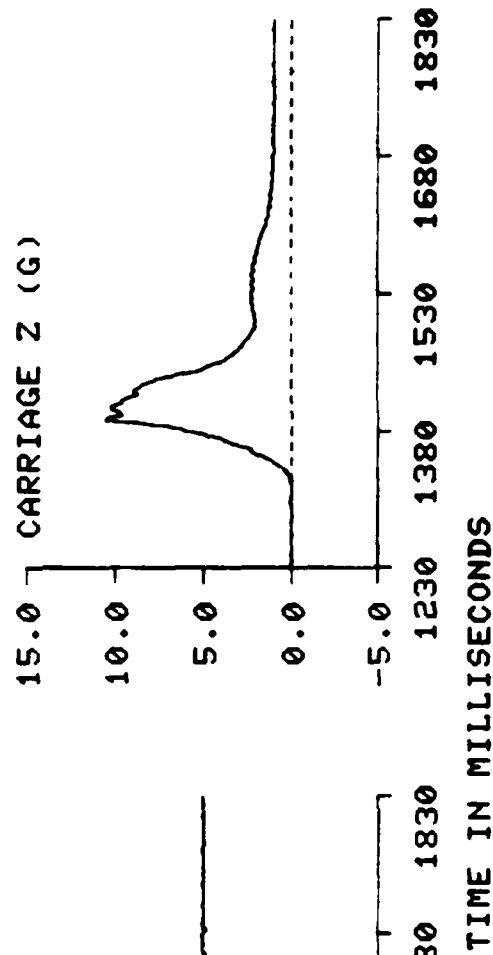
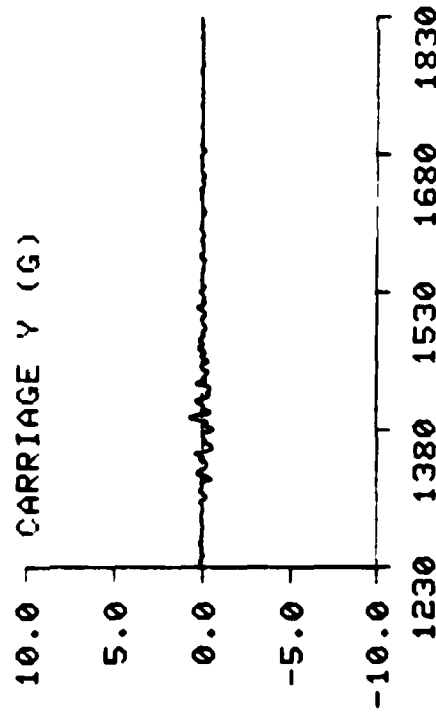
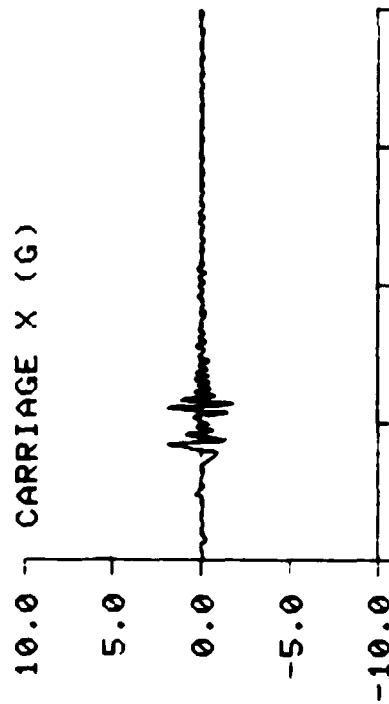
VERTICAL TEST PHASE      TEST: 709      SUBJ: W-3      WT: 175.0      CELL: E

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1240		
TIME OF IMPACT START				1365		
CARRIAGE ACCELERATION (G)						
X AXIS			1.55	1408	-1.74	1410
Y AXIS			0.29	1508	-0.93	1432
Z AXIS			10.51	1403	-0.12	1270
Z AXIS (SMOOTHED)			9.94	1414	-0.04	1269
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1360	-26.17	1730
TACHOMETER (MEASURED)			-1.16	1807	-26.31	1365
SEAT ACCELERATION (G)						
X AXIS			1.23	1416	-1.72	1412
Y AXIS			0.63	1408	-0.45	1468
Z AXIS			11.69	1404	-0.23	1252
Z AXIS (SMOOTHED)			10.79	1404	-0.14	1250
CHEST ACCELERATION (G)						
X AXIS			0.63	1506	-0.61	1458
Y AXIS			0.63	1406	-1.82	1424
Z AXIS			18.75	1422	-0.74	1522
RESULTANT			18.84	1422	0.32	1274
CHEST SEVERITY INDEX			38.83			
HEAD ACCELERATION (G)						
X AXIS			2.91	1424	-1.36	1464
Y AXIS			0.96	1622	-0.60	1438
Z AXIS			13.75	1424	-0.26	1304
RESULTANT			14.05	1421	0.42	1268
HEAD SEVERITY INDEX			26.38			
SHOULDER STRAP LOADS (LB)						
X AXIS	51.89	1252	161.83	1450		
Y AXIS	5.19	1138	12.17	1428		
Z AXIS	1.98	511	29.22	1437		
RESULTANT	52.33	1252	164.28	1450		
LEFT LAP LOADS (LB)						
X AXIS	72.73	1341	72.73	1434	45.32	1386
Y AXIS	23.76	1321	19.64	1437	11.98	1397
Z AXIS	67.65	1308	47.40	1465	21.08	1403
RESULTANT	101.86	1349	87.69	1434	52.64	1404
RIGHT LAP LOADS (LB)						
X AXIS	65.25	1310	58.87	1428	37.17	1392
Y AXIS	22.58	1300	19.99	1433	10.27	1405
Z AXIS	68.57	1307	38.32	1642	14.33	1405
RESULTANT	96.43	1310	69.42	1428	44.63	1405
TOTAL LAP LOAD (LB)	196.40	1310	156.37	1434	97.41	1405
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	11.58	629	28.03	1489	-61.55	1409
X AXIS (RIGHT)	14.20	506	4.26	1390	-17.38	1429
X AXIS (SUM)	20.29	507	27.00	1492	-68.99	1409
Y AXIS (CENTER)	77.67	508	50.37	1511	2.11	1416
SEAT LOADS (LB)						
Z AXIS (LEFT)	48.86	505	488.39	1428	19.55	1265
Z AXIS (RIGHT)	70.00	505	389.32	1418	37.65	1655
Z AXIS (CENTER)	121.02	1350	1402.42	1420	94.18	1241
Z AXIS (SUM)	239.88	505	2218.02	1420	160.38	1240
SEAT Z SUM / WT	1.32	505	12.67	1420	0.92	1240
RESULTANT SEAT LOAD (LB)	243.77	505	2218.85	1420	165.21	1240

VERTICAL TEST PHASE      TEST: 647      SUBJ: W-4      WT: 192.0      CELL: E

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1204		
TIME OF IMPACT START				1328		
CARRIAGE ACCELERATION (G)						
X AXIS			2.32	1334	-2.44	1339
Y AXIS			0.58	1370	-0.90	1336
Z AXIS			10.57	1365	-0.10	1269
Z AXIS (SMOOTHED)			9.90	1377	-0.03	1265
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1324	-26.04	1627
TACHOMETER (MEASURED)			-1.16	1696	-26.15	1328
SEAT ACCELERATION (G)						
X AXIS			1.90	1394	-1.93	1374
Y AXIS			1.69	1378	-1.09	1348
Z AXIS			11.47	1370	-0.11	1205
Z AXIS (SMOOTHED)			10.77	1368	-0.06	1264
CHEST ACCELERATION (G)						
X AXIS			1.38	1391	-1.10	1418
Y AXIS			0.27	1473	-2.04	1399
Z AXIS			22.33	1392	-0.68	1203
RESULTANT			22.40	1389	0.19	1330
CHEST SEVERITY INDEX			41.57			
HEAD ACCELERATION (G)						
X AXIS			4.87	1389	-0.43	1755
Y AXIS			1.25	1214	-0.48	1399
Z AXIS			12.60	1388	-0.95	1254
RESULTANT			13.50	1385	0.44	1470
HEAD SEVERITY INDEX			22.79			
SHOULDER STRAP LOADS (LB)						
X AXIS	60.63	672	200.54	1421		
Y AXIS	2.56	767	3.72	1397		
Z AXIS	3.20	469	41.58	1408		
RESULTANT	60.75	682	204.59	1421		
LEFT LAP LOADS (LB)						
X AXIS	97.69	1312	93.96	1400	46.62	1366
Y AXIS	30.06	1306	21.81	1437	12.97	1375
Z AXIS	104.75	1313	70.32	1427	24.76	1367
RESULTANT	145.53	1313	118.67	1400	54.80	1367
RIGHT LAP LOADS (LB)						
X AXIS	89.07	1312	85.24	1401	38.01	1366
Y AXIS	35.80	1310	31.26	1403	13.12	1368
Z AXIS	103.38	1311	72.09	1431	16.81	1367
RESULTANT	141.08	1312	111.97	1401	44.43	1368
TOTAL LAP LOAD (LB)	285.64	1313	230.47	1400	99.70	1367
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	0.63	553	12.82	1461	-53.00	1384
X AXIS (RIGHT)	9.44	581	8.12	1481	-35.16	1391
X AXIS (SUM)	1.71	556	17.28	1482	-86.33	1391
Y AXIS (CENTER)	0.97	524	-1.57	1336	-56.18	1370
SEAT LOADS (LB)						
Z AXIS (LEFT)	85.47	1309	574.92	1383	32.78	1665
Z AXIS (RIGHT)	47.61	468	521.52	1383	23.74	1216
Z AXIS (CENTER)	144.62	1312	1313.48	1382	84.62	1204
Z AXIS (SUM)	244.02	1312	2409.89	1383	150.87	1204
SEAT Z SUM / WT	1.27	1312	12.55	1383	0.79	1204
RESULTANT SEAT LOAD (LB)	244.82	1312	2411.76	1383	151.23	1204

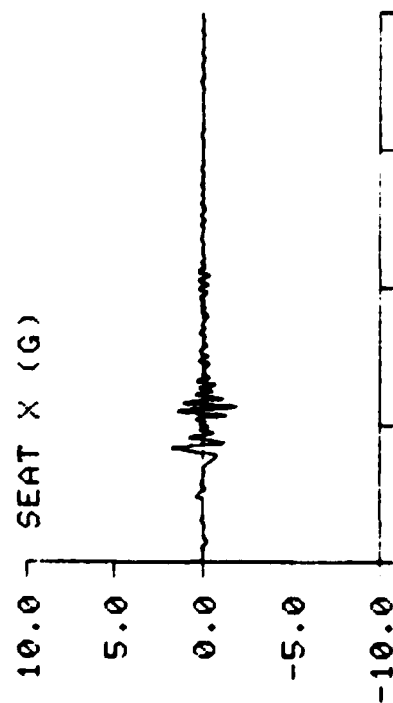




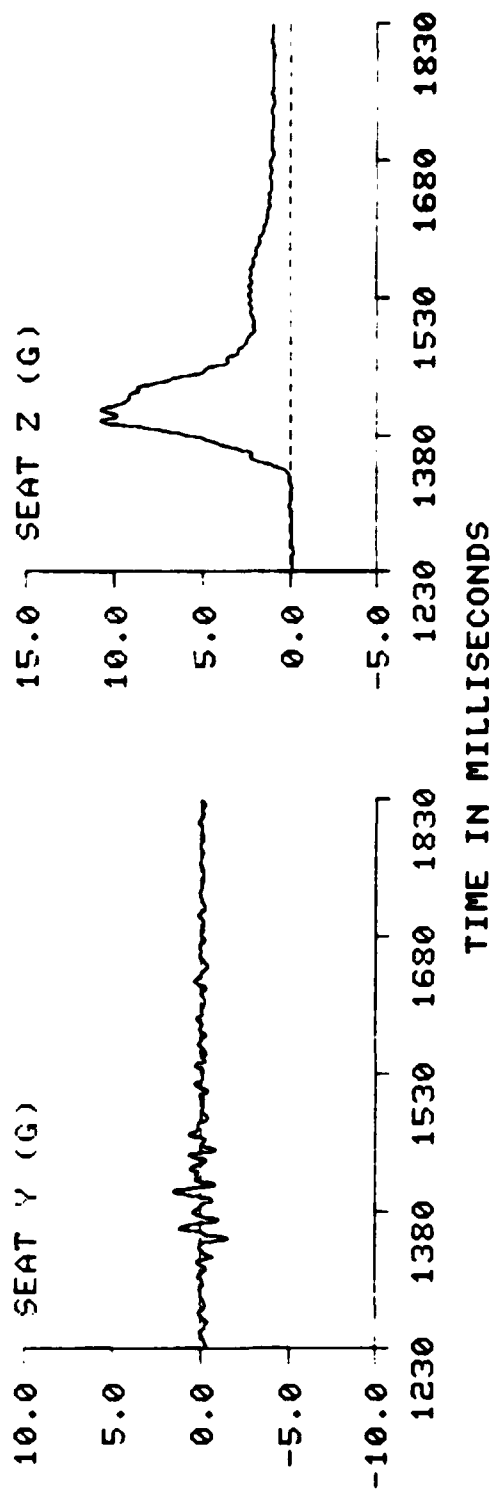
RESTRAINT CONFIGURATION STUDY

TEST NO: 702

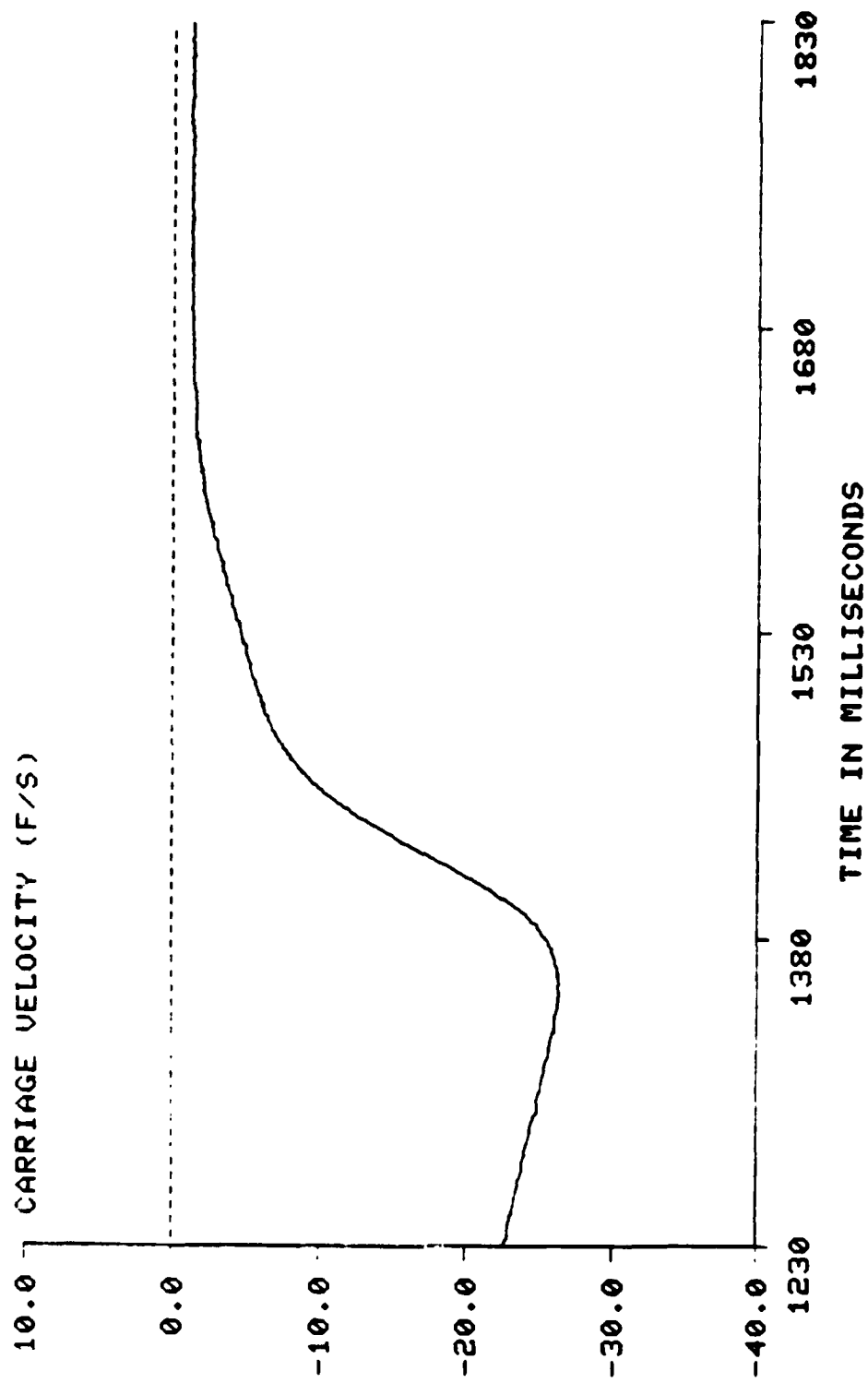
SUBJ ID: R-2



204



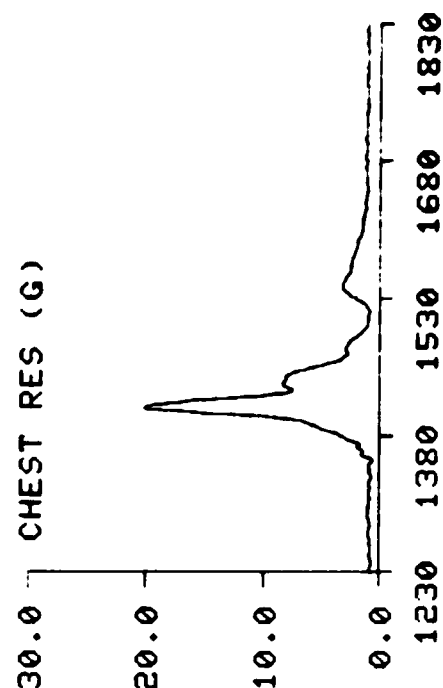
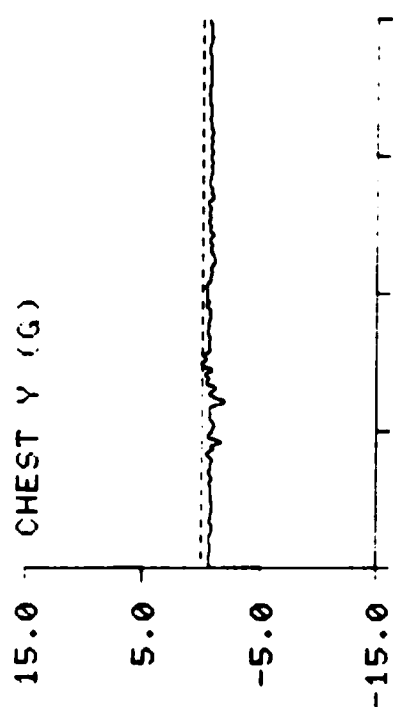
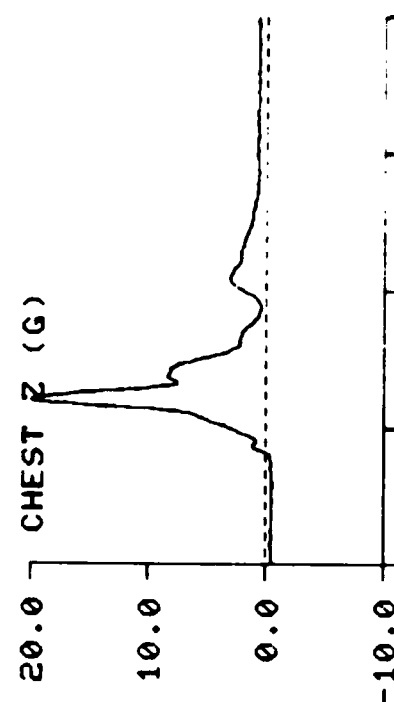
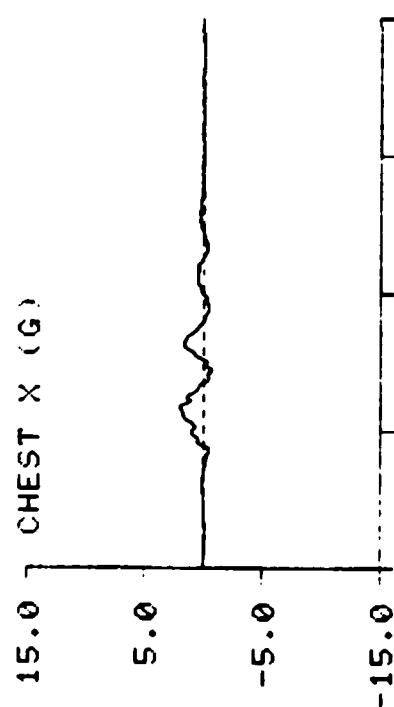
RESTRAINT CONFIGURATION STUDY      TEST NO: 702      SUBJ ID: R-2



RESTRAINT CONFIGURATION STUDY

TEST NO: 702

SUBJ ID: R-2

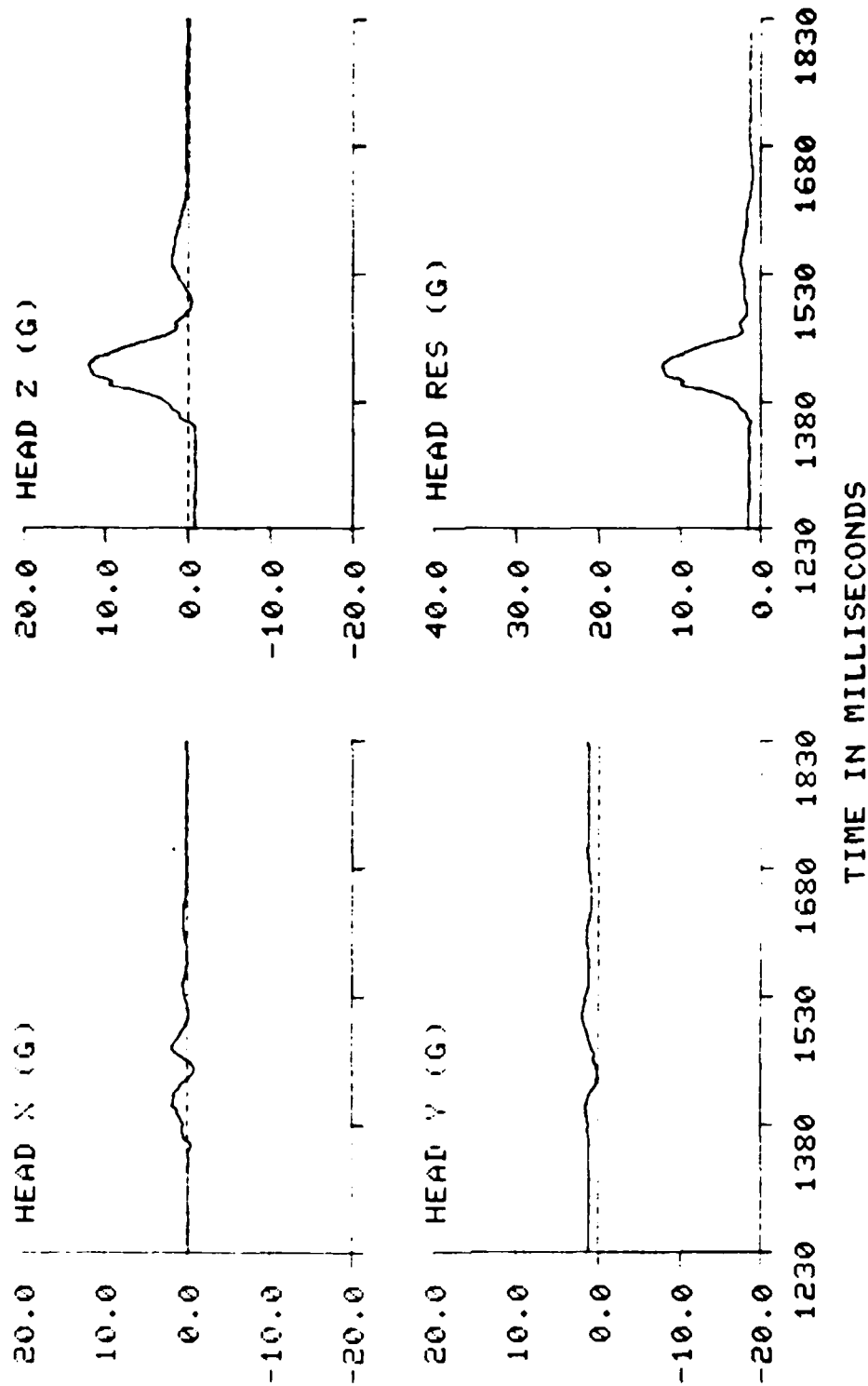


TIME IN MILLISECONDS

# RESTRAINT CONFIGURATION STUDY

TEST NO: 702

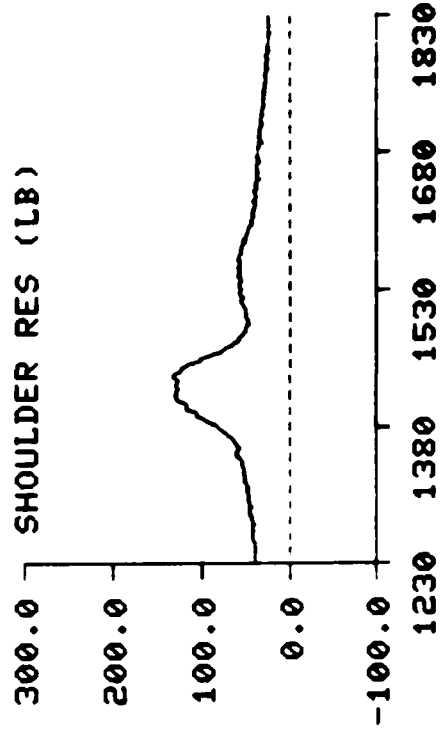
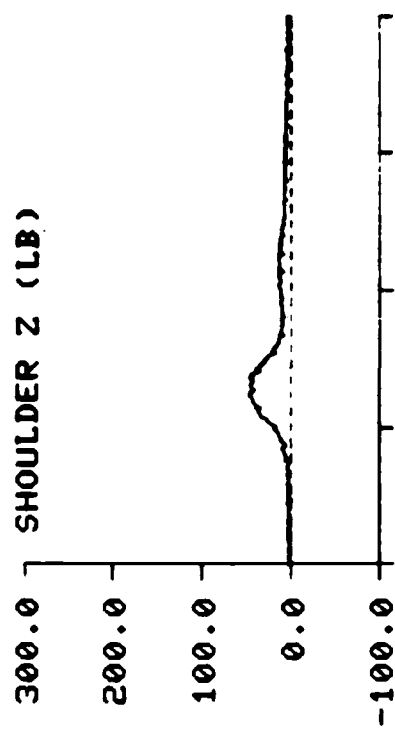
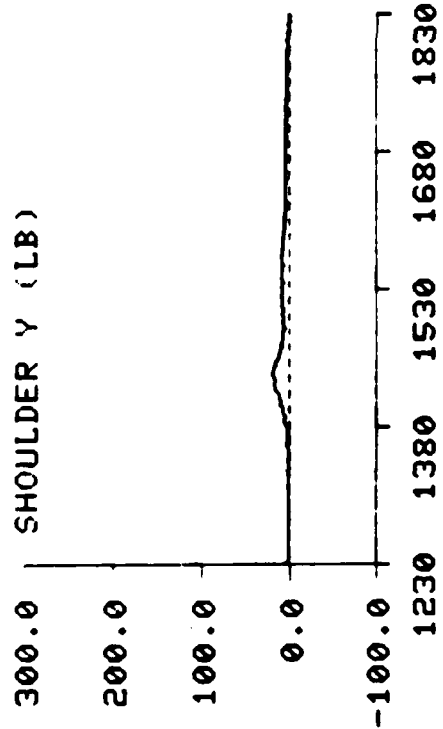
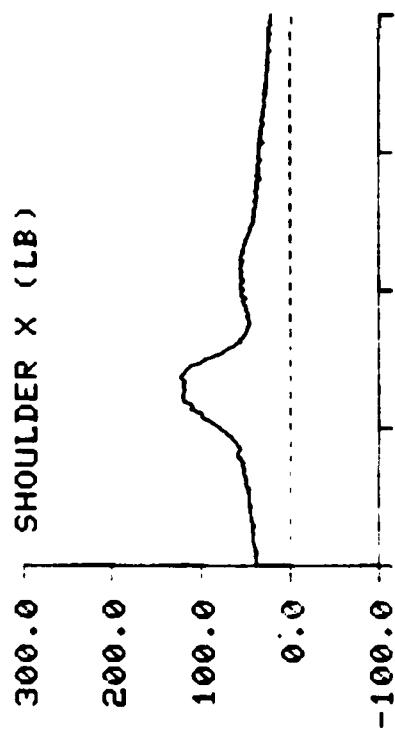
SUBJ ID: R-2



# RESTRAINT CONFIGURATION STUDY

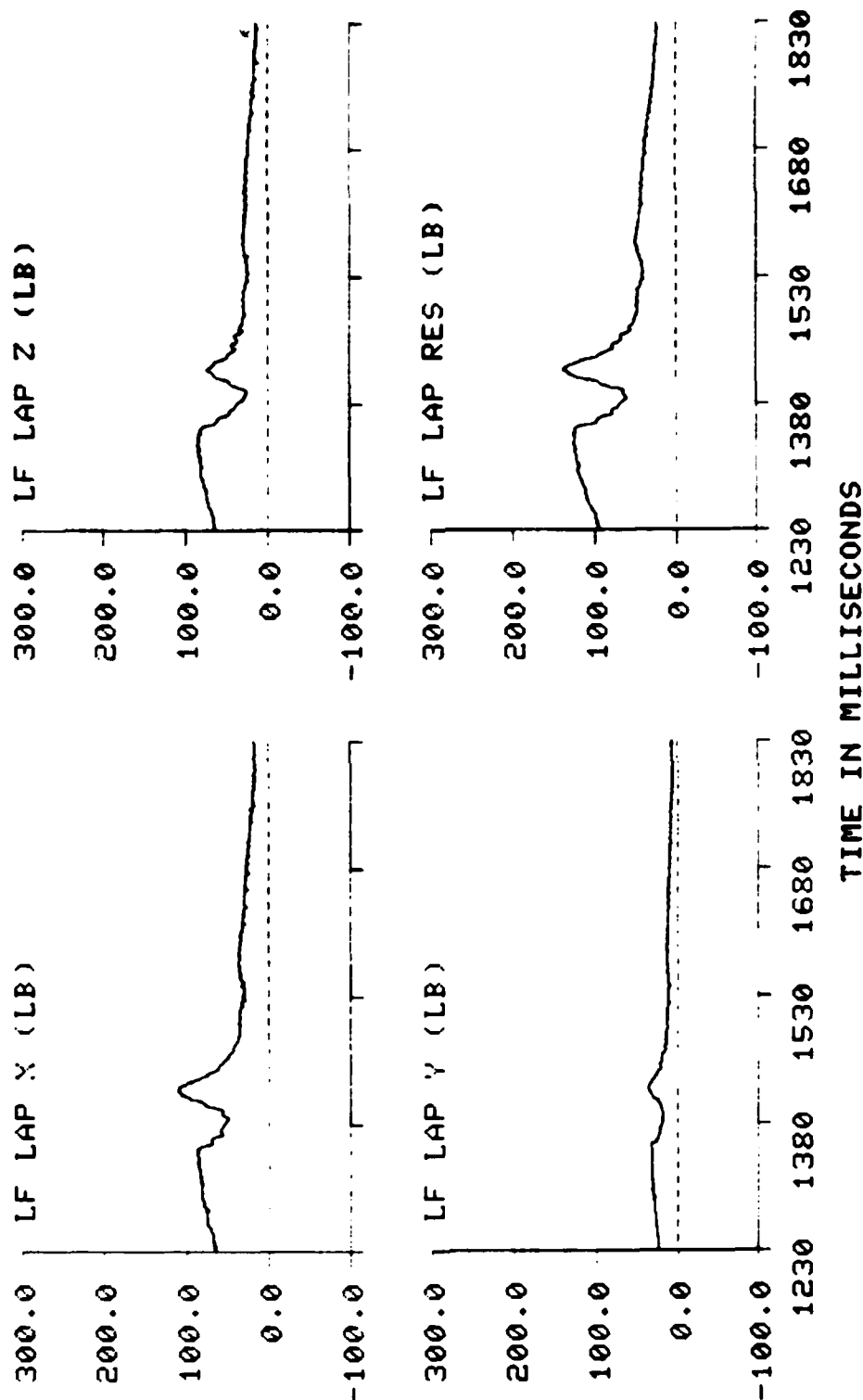
TEST NO: 702

SUBJ ID: R-2

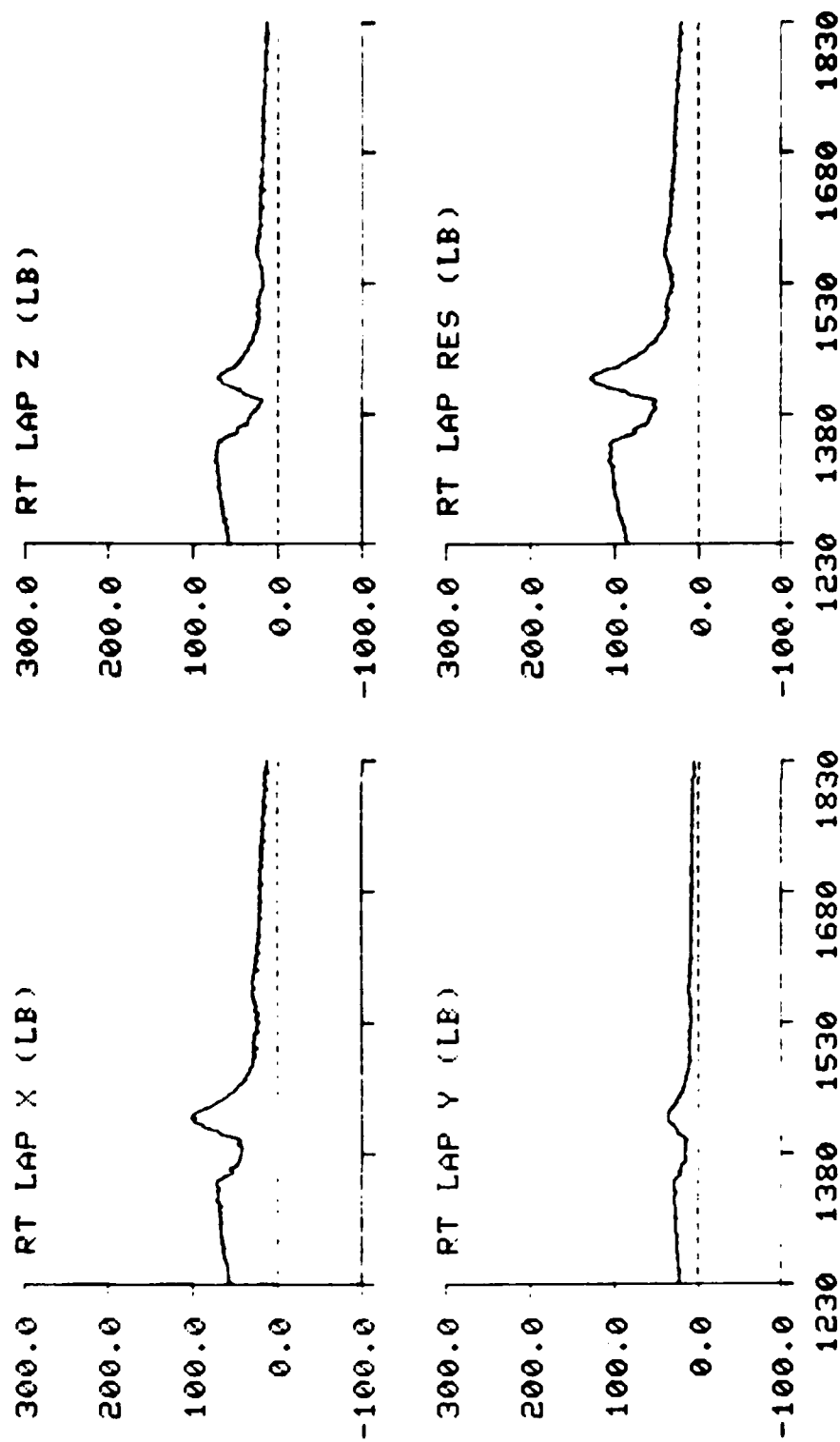


TIME IN MILLISECONDS

RESTRAINT CONFIGURATION STUDY      TEST NO: 702      SUBJ ID: R-2



RESTRAINT CONFIGURATION STUDY      TEST NO: 702      SUBJ ID: R-2

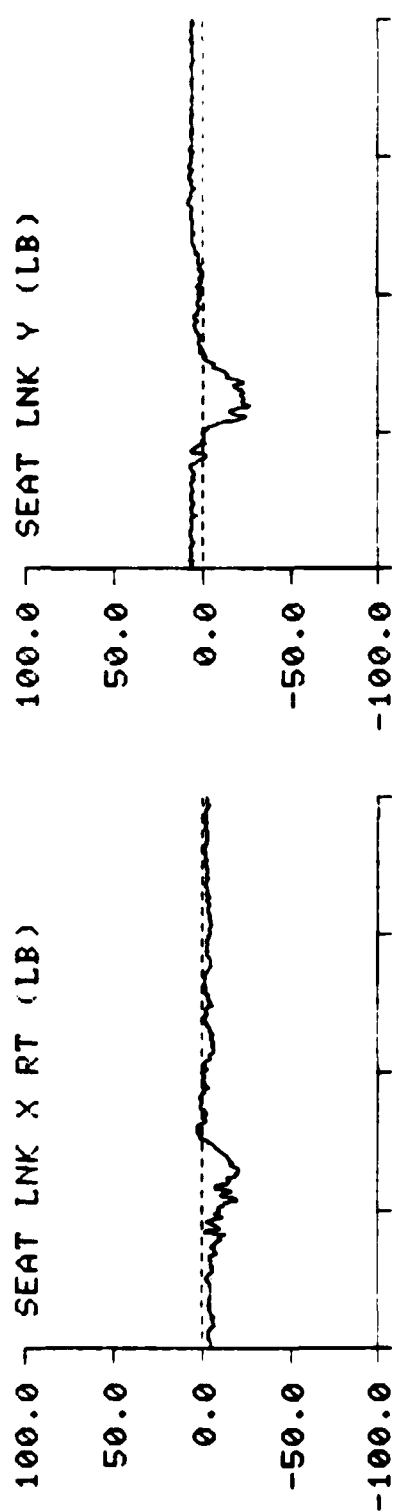
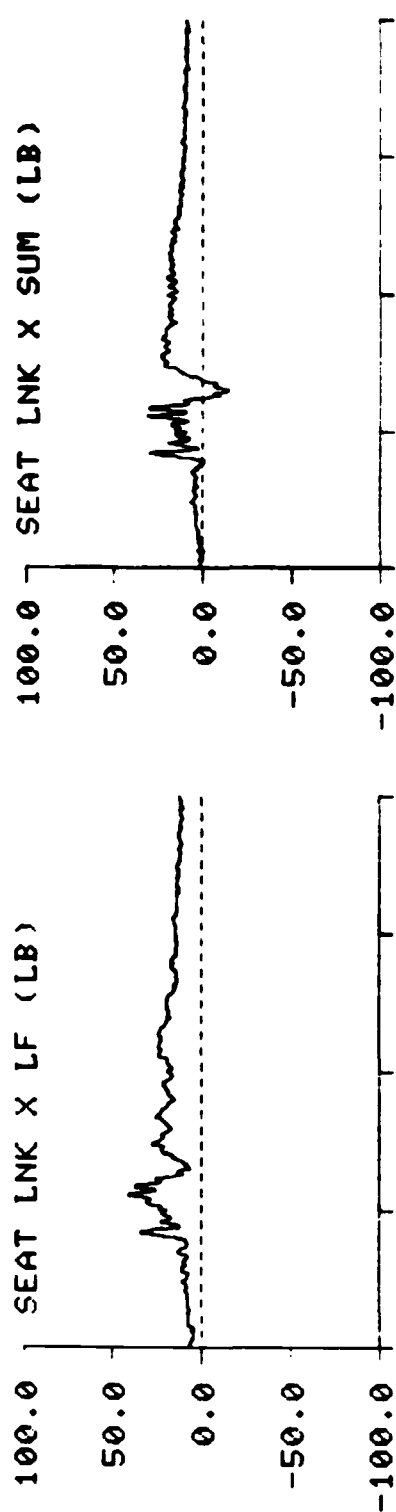




# RESTRAINT CONFIGURATION STUDY

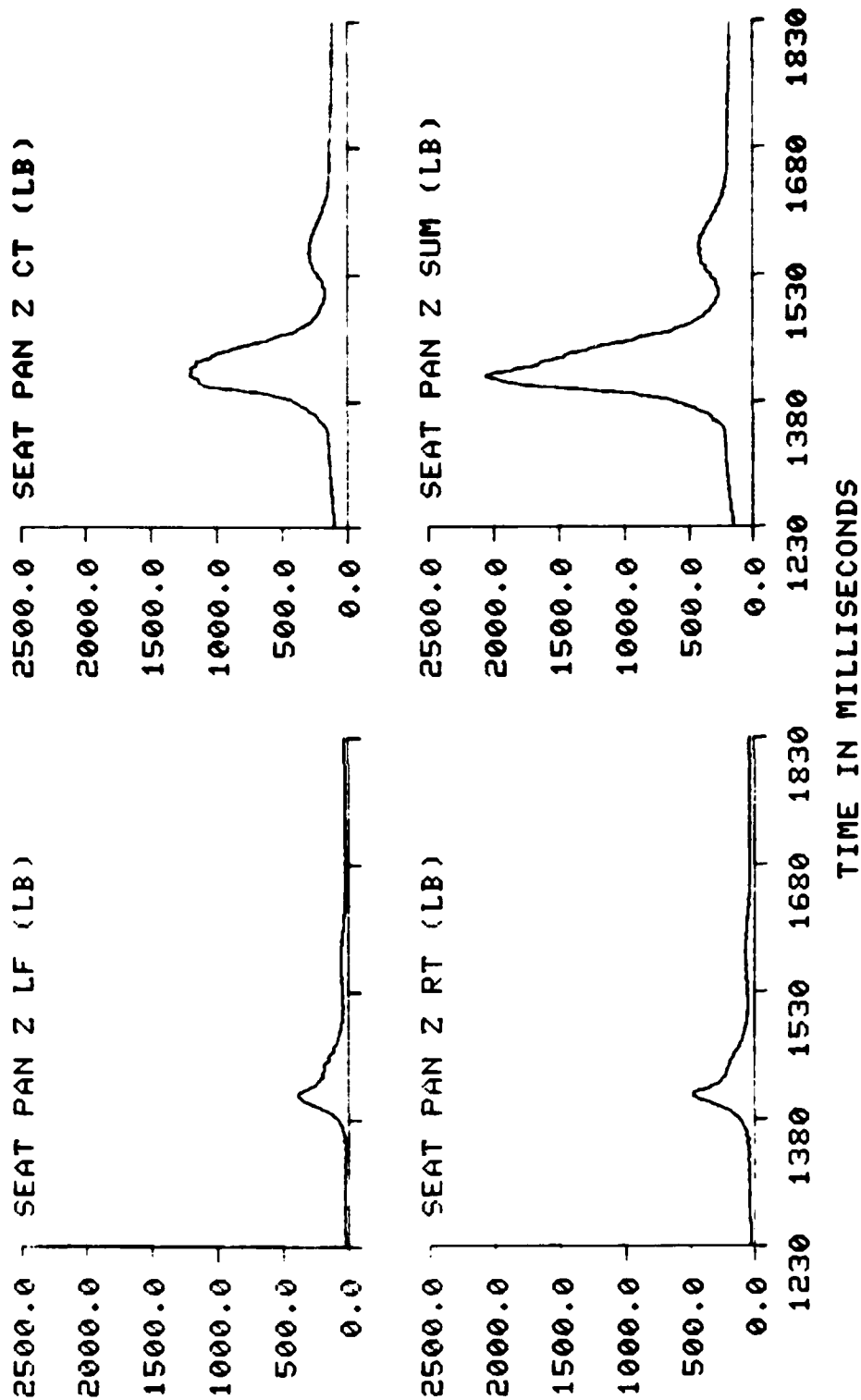
TEST NO: 702

SUBJ ID: R-2



TIME IN MILLISECONDS

RESTRAINT CONFIGURATION STUDY      TEST NO: 702      SUBJ ID: R-2



VERTICAL TEST PHASE		TEST: 687	SUBJ: B-2	WT: 188.0	CELL: F	
PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1294		
TIME OF IMPACT START				1303		
CARRIAGE ACCELERATION (G)						
X AXIS			2.23	1356	-1.68	1364
Y AXIS			0.99	1482	-0.61	1458
Z AXIS			10.59	1397	-0.06	1326
Z AXIS (SMOOTHED)			9.94	1407	-0.03	1319
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1351	-26.09	1698
TACHOMETER (MEASURED)			-1.23	1714	-26.22	1363
SEAT ACCELERATION (G)						
X AXIS			1.81	1356	-1.47	1406
Y AXIS			1.04	1408	-0.67	1358
Z AXIS			11.80	1400	-0.18	1310
Z AXIS (SMOOTHED)			10.73	1398	-0.13	1266
CHEST ACCELERATION (G)						
X AXIS			1.95	1420	-0.41	1458
Y AXIS			0.52	1558	-1.89	1416
Z AXIS			19.70	1418	-0.52	1282
RESULTANT			19.83	1415	0.24	1331
CHEST SEVERITY INDEX			34.70			
HEAD ACCELERATION (G)						
X AXIS			3.72	1408	-1.38	1480
Y AXIS			0.58	1492	-1.54	1420
Z AXIS			11.88	1404	-0.49	1270
RESULTANT			12.52	1404	0.28	1356
HEAD SEVERITY INDEX			19.12			
NEGATIVE G STRAP	112.37	1339	34.87	1431	-6.25	1410
SHOULDER STRAP LOADS (LB)						
X AXIS	107.98	1340	190.93	1414		
Y AXIS	3.71	500	10.69	1423		
Z AXIS	1.44	506	34.87	1431		
RESULTANT	108.42	1340	193.84	1427		
LEFT LAP LOADS (LB)						
X AXIS	74.45	1338	57.01	1451	22.12	1399
Y AXIS	16.51	1337	11.21	1451	1.78	1405
Z AXIS	72.23	1343	36.79	1450	1.36	1397
RESULTANT	104.94	1345	68.23	1451	22.66	1399
RIGHT LAP LOADS (LB)						
X AXIS	74.78	1325	67.12	1451	28.82	1396
Y AXIS	12.47	1267	8.58	1453	-1.14	1412
Z AXIS	80.29	1327	47.98	1452	6.24	1400
RESULTANT	109.46	1325	82.27	1450	29.53	1400
TOTAL LAP LOAD (LB)	212.94	1344	149.92	1450	52.39	1399
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	47.83	501	131.32	1440	-12.51	1419
X AXIS (RIGHT)	15.47	500	11.38	1437	-30.14	1385
X AXIS (SUM)	63.30	501	134.98	1439	-39.67	1413
Y AXIS (CENTER)	-22.76	575	-18.31	1361	-112.92	1412
SEAT LOADS (LB)						
Z AXIS (LEFT)	33.40	500	946.67	1438	-3.73	1361
Z AXIS (RIGHT)	64.04	500	920.31	1438	24.57	1245
Z AXIS (CENTER)	225.50	1323	1532.34	1414	152.54	1813
Z AXIS (SUM)	267.18	1342	2798.15	1438	215.88	1814
SEAT Z SUM / WT	1.42	1342	14.88	1438	1.15	1814
RESULTANT SEAT LOAD (LB)	269.05	1342	2801.73	1438	218.38	1814

VERTICAL TEST PHASE		TEST: 703	SUBJ: B-1	WT: 155.0	CELL: F	
PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1250		
TIME OF IMPACT START				1378		
CARRIAGE ACCELERATION (G)						
X AXIS			2.27	1418	-2.36	1420
Y AXIS			1.50	1428	-0.64	1380
Z AXIS			10.79	1413	-0.15	1344
Z AXIS (SMOOTHED)			9.95	1417	-0.03	1340
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1369	-26.01	1713
TACHOMETER (MEASURED)			-1.18	1772	-26.42	1378
SEAT ACCELERATION (G)						
X AXIS			1.64	1418	-2.14	1422
Y AXIS			1.50	1386	-1.63	1470
Z AXIS			12.52	1418	-0.31	1348
Z AXIS (SMOOTHED)			11.09	1415	-0.20	1275
CHEST ACCELERATION (G)						
X AXIS			4.70	1428	-0.33	1378
Y AXIS			0.51	1512	-3.16	1438
Z AXIS			20.91	1434	-0.34	1318
RESULTANT			21.37	1431	0.11	1362
CHEST SEVERITY INDEX			38.81			
HEAD ACCELERATION (G)						
X AXIS			1.27	1544	-2.08	1472
Y AXIS			1.53	1552	-0.28	1464
Z AXIS			14.56	1434	-0.55	1316
RESULTANT			14.58	1431	0.49	1326
HEAD SEVERITY INDEX			23.44			
NEGATIVE G STRAP	31.48	1346	14.54	1529	-9.94	1428
SHOULDER STRAP LOADS (LB)						
X AXIS	52.43	1361	99.40	1457		
Y AXIS	3.01	941	11.74	1453		
Z AXIS	2.01	523	32.96	1433		
RESULTANT	52.47	1361	103.37	1457		
LEFT LAP LOADS (LB)						
X AXIS	52.62	1356	63.83	1439	35.18	1398
Y AXIS	14.30	1353	13.12	1447	4.87	1410
Z AXIS	45.56	1346	35.44	1671	6.07	1415
RESULTANT	70.94	1361	71.27	1439	36.48	1410
RIGHT LAP LOADS (LB)						
X AXIS	47.38	1358	60.15	1441	29.51	1405
Y AXIS	17.30	1343	21.19	1435	7.58	1401
Z AXIS	46.54	1348	32.98	1442	5.88	1414
RESULTANT	67.07	1359	70.43	1441	32.70	1415
TOTAL LAP LOAD (LB)	137.48	1359	140.68	1439	71.96	1415
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	18.36	519	14.09	1505	-53.56	1430
X AXIS (RIGHT)	26.84	517	12.81	1535	-20.53	1420
X AXIS (SUM)	43.98	517	23.87	1534	-67.04	1429
Y AXIS (CENTER)	71.71	519	29.17	1783	-12.74	1425
SEAT LOADS (LB)						
Z AXIS (LEFT)	34.77	516	297.72	1435	11.21	1368
Z AXIS (RIGHT)	40.23	1331	345.04	1430	19.73	1252
Z AXIS (CENTER)	123.49	516	1401.20	1430	55.70	1257
Z AXIS (SUM)	188.80	516	2025.22	1430	105.47	1252
SEAT Z SUM / WT	1.22	516	13.07	1430	0.68	1252
RESULTANT SEAT LOAD (LB)	205.21	516	2026.29	1430	108.19	1252

VERTICAL TEST PHASE      TEST: 688      SUBJ: B-3      WT: 180.0      CELL: F

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1250		
TIME OF IMPACT START				1377		
CARRIAGE ACCELERATION (G)						
X AXIS			1.52	1416	-1.73	1418
Y AXIS			0.33	1426	-0.43	1436
Z AXIS			10.66	1411	-0.11	1332
Z AXIS (SMOOTHED)			9.94	1415	-0.04	1250
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1367	-25.99	1700
TACHOMETER (MEASURED)			-1.19	1785	-26.28	1377
SEAT ACCELERATION (G)						
X AXIS			1.27	1424	-1.62	1420
Y AXIS			1.30	1418	-0.65	1386
Z AXIS			12.26	1412	-0.22	1280
Z AXIS (SMOOTHED)			10.97	1412	-0.13	1277
CHEST ACCELERATION (G)						
X AXIS			2.11	1438	-1.14	1468
Y AXIS			0.51	1470	-1.11	1434
Z AXIS			17.04	1436	-0.47	1344
RESULTANT			17.20	1433	0.24	1323
CHEST SEVERITY INDEX			31.94			
HEAD ACCELERATION (G)						
X AXIS			3.71	1432	-0.23	1374
Y AXIS			1.04	1522	0.30	1436
Z AXIS			13.06	1438	-0.80	1324
RESULTANT			13.49	1435	0.50	1371
HEAD SEVERITY INDEX			21.68			
NEGATIVE G STRAP	104.04	1355	37.72	1445	-3.90	1429
SHOULDER STRAP LOADS (LB)						
X AXIS	69.90	846	133.86	1451		
Y AXIS	11.96	1255	28.25	1457		
Z AXIS	5.52	516	37.72	1445		
RESULTANT	70.22	846	141.47	1451		
LEFT LAP LOADS (LB)						
X AXIS	108.71	1280	76.32	1454	50.15	1413
Y AXIS	40.54	1279	25.80	1452	15.78	1416
Z AXIS	102.84	1279	49.18	1464	22.86	1413
RESULTANT	154.17	1279	93.70	1454	57.85	1413
RIGHT LAP LOADS (LB)						
X AXIS	107.43	1295	70.41	1446	47.43	1412
Y AXIS	24.37	1232	14.00	1440	8.17	1413
Z AXIS	111.87	1276	46.16	1445	23.22	1412
RESULTANT	156.16	1295	84.30	1445	53.65	1412
TOTAL LAP LOAD (LB)	308.79	1295	174.03	1449	112.07	1414
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	34.07	516	49.91	1456	13.96	1433
X AXIS (RIGHT)	30.44	515	21.09	1715	-14.58	1427
X AXIS (SUM)	63.93	516	46.27	1468	1.18	1426
Y AXIS (CENTER)	-25.39	604	-31.10	1507	-113.01	1426
SEAT LOADS (LB)						
Z AXIS (LEFT)	51.23	514	437.06	1448	-0.65	1585
Z AXIS (RIGHT)	87.83	1218	573.26	1444	46.06	1753
Z AXIS (CENTER)	270.46	1357	1509.22	1430	166.90	1841
Z AXIS (SUM)	342.07	1358	2341.32	1436	246.23	1842
SEAT Z SUM / WT	1.90	1358	13.01	1436	1.37	1842
RESULTANT SEAT LOAD (LB)	345.42	1358	2343.73	1436	251.10	1842

VERTICAL TEST PHASE      TEST: 723      SUBJ: C-1      WT: 172.0      CELL: F

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1220		
TIME OF IMPACT START				1350		
CARRIAGE ACCELERATION (G)						
X AXIS			1.56	1388	-1.80	1390
Y AXIS			1.18	1394	-0.66	1408
Z AXIS			10.72	1383	-0.11	1302
Z AXIS (SMOOTHED)			9.94	1387	-0.02	1289
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1342	-26.16	1686
TACHOMETER (MEASURED)			-1.19	1708	-26.25	1350
SEAT ACCELERATION (G)						
X AXIS			1.40	1348	-1.76	1392
Y AXIS			1.58	1392	-1.33	1436
Z AXIS			12.28	1386	-0.21	1246
Z AXIS (SMOOTHED)			11.04	1384	-0.15	1242
CHEST ACCELERATION (G)						
X AXIS			1.44	1400	-1.56	1428
Y AXIS			0.45	1470	-1.76	1404
Z AXIS			16.97	1406	-0.69	1310
RESULTANT			17.06	1403	0.25	1501
CHEST SEVERITY INDEX			32.65			
HEAD ACCELERATION (G)						
X AXIS			5.23	1404	-0.31	1496
Y AXIS			1.32	1480	-0.99	1408
Z AXIS			11.16	1408	-0.78	1290
RESULTANT			12.36	1404	0.75	1466
HEAD SEVERITY INDEX			23.05			
NEGATIVE G STRAP	100.59	1325	46.62	1493	-4.84	1398
SHOULDER STRAP LOADS (LB)						
X AXIS	113.17	1330	222.11	1424		
Y AXIS	9.85	1159	6.76	1436		
Z AXIS	0.35	1023	38.73	1421		
RESULTANT	113.33	1330	225.53	1424		
LEFT LAP LOADS (LB)						
X AXIS	123.85	1329	117.63	1415	83.99	1384
Y AXIS	32.96	1330	27.65	1411	19.40	1389
Z AXIS	108.33	1322	74.92	1418	46.57	1385
RESULTANT	187.82	1330	141.31	1415	88.96	1384
RIGHT LAP LOADS (LB)						
X AXIS	102.53	1324	93.59	1417	60.40	1384
Y AXIS	29.09	1328	27.14	1419	14.18	1384
Z AXIS	107.18	1327	69.63	1418	35.21	1385
RESULTANT	151.02	1327	118.77	1418	71.47	1385
TOTAL LAP LOAD (LB)	317.98	1330	258.58	1415	170.88	1385
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	7.14	487	13.85	1470	-28.21	1400
X AXIS (RIGHT)	8.06	486	5.13	1453	-27.03	1410
X AXIS (SUM)	14.03	487	14.89	1470	-50.56	1400
Y AXIS (CENTER)	4.89	562	-0.39	1647	-57.54	1398
SEAT LOADS (LB)						
Z AXIS (LEFT)	51.59	1224	412.81	1408	38.24	1271
Z AXIS (RIGHT)	46.18	1321	429.13	1408	26.54	1263
Z AXIS (CENTER)	229.01	1330	1342.41	1400	142.32	1809
Z AXIS (SUM)	321.68	1330	2151.59	1400	232.12	1781
SEAT Z SUM / WT	1.87	1330	12.51	1400	1.35	1781
RESULTANT SEAT LOAD (LB)	322.19	1330	2152.82	1400	232.13	1781

VERTICAL TEST PHASE      TEST: 704      SUBJ: C-2      WT: 177.0      CELL: F

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1230		
TIME OF IMPACT START				1356		
CARRIAGE ACCELERATION (G)						
X AXIS			1.70	1398	-1.69	1402
Y AXIS			0.35	1332	-0.60	1398
Z AXIS			10.53	1392	-0.12	1320
Z AXIS (SMOOTHED)			9.92	1404	-0.03	1315
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1350	-25.96	1712
TACHOMETER (MEASURED)			-1.12	1802	-26.39	1356
SEAT ACCELERATION (G)						
X AXIS			1.32	1394	-1.83	1402
Y AXIS			1.36	1404	-0.68	1350
Z AXIS			11.85	1408	-0.16	1234
Z AXIS (SMOOTHED)			10.92	1395	-0.13	1233
CHEST ACCELERATION (G)						
X AXIS			2.49	1398	-0.71	1432
Y AXIS			0.21	1396	-3.99	1410
Z AXIS			19.66	1410	-0.60	1264
RESULTANT			20.12	1410	0.16	1502
CHEST SEVERITY INDEX			36.65			
HEAD ACCELERATION (G)						
X AXIS			2.03	1402	-2.33	1462
Y AXIS			2.18	1486	0.68	1444
Z AXIS			11.92	1402	-0.57	1316
RESULTANT			12.12	1402	0.90	1818
HEAD SEVERITY INDEX			22.70			
NEGATIVE G STRAP	50.61	1338	41.82	1484	2.91	1396
SHOULDER STRAP LOADS (LB)						
X AXIS	45.87	1339	170.80	1440		
Y AXIS	0.30	687	18.34	1445		
Z AXIS	3.64	1338	45.74	1430		
RESULTANT	45.98	1339	176.73	1440		
LEFT LAP LOADS (LB)						
X AXIS	55.61	1335	78.04	1424	43.15	1375
Y AXIS	19.89	1330	25.78	1424	15.17	1378
Z AXIS	51.31	1334	52.32	1453	18.91	1392
RESULTANT	78.24	1340	95.31	1424	56.05	1383
RIGHT LAP LOADS (LB)						
X AXIS	49.58	1340	73.83	1420	39.37	1372
Y AXIS	9.88	1336	11.82	1452	4.04	1386
Z AXIS	48.42	1327	50.50	1464	15.04	1394
RESULTANT	68.21	1336	85.97	1420	44.84	1385
TOTAL LAP LOAD (LB)	146.02	1340	180.13	1423	101.37	1385
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	7.75	1332	24.82	1448	-11.75	1399
X AXIS (RIGHT)	-2.39	578	-5.89	1518	-79.58	1410
X AXIS (SUM)	2.34	620	6.91	1486	-84.90	1399
Y AXIS (CENTER)	7.07	613	6.44	1235	-24.68	1394
SEAT LOADS (LB)						
Z AXIS (LEFT)	41.29	1334	359.89	1410	21.91	1230
Z AXIS (RIGHT)	56.60	495	565.22	1411	21.43	1242
Z AXIS (CENTER)	115.23	496	1258.40	1410	53.89	1236
Z AXIS (SUM)	208.35	495	2180.78	1411	104.01	1230
SEAT Z SUM / WT	1.18	495	12.32	1411	0.59	1230
RESULTANT SEAT LOAD (LB)	208.65	495	2182.25	1411	104.17	1230

VERTICAL TEST PHASE	TEST: 714	SUBJ: E-2	WT: 169.0	CELL: F		
PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1228		
TIME OF IMPACT START				1352		
CARRIAGE ACCELERATION (G)						
X AXIS			1.72	1350	-1.67	1400
Y AXIS			0.47	1348	-0.50	1438
Z AXIS			10.75	1390	-0.12	1248
Z AXIS (SMOOTHED)			10.09	1402	-0.03	1286
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1348	-26.20	1668
TACHOMETER (MEASURED)			-1.20	1713	-26.25	1352
SEAT ACCELERATION (G)						
X AXIS			1.56	1350	-1.54	1396
Y AXIS			1.53	1396	-0.80	1350
Z AXIS			12.43	1390	-0.08	1272
Z AXIS (SMOOTHED)			10.98	1390	-0.04	1262
CHEST ACCELERATION (G)						
X AXIS			2.94	1398	-1.16	1438
Y AXIS			0.17	1496	-1.78	1472
Z AXIS			13.91	1414	-0.69	1268
RESULTANT			14.10	1410	0.54	1496
CHEST SEVERITY INDEX			26.29			
HEAD ACCELERATION (G)						
X AXIS			2.78	1400	-0.49	1513
Y AXIS			1.42	1560	-0.10	1430
Z AXIS			11.14	1410	-0.76	1226
RESULTANT			11.41	1405	0.76	1645
HEAD SEVERITY INDEX			19.39			
NEGATIVE G STRAP	120.41	1339	71.46	1497	-1.97	1408
SHOULDER STRAP LOADS (LB)						
X AXIS	154.67	1292	308.58	1436		
Y AXIS	8.43	1334	28.79	1443		
Z AXIS	8.69	846	64.42	1429		
RESULTANT	154.87	1292	316.09	1436		
LEFT LAP LOADS (LB)						
X AXIS	144.09	1338	154.05	1444	104.22	1393
Y AXIS	37.36	1337	39.71	1444	23.21	1399
Z AXIS	123.05	1339	114.95	1445	67.37	1392
RESULTANT	193.13	1339	196.27	1442	128.03	1393
RIGHT LAP LOADS (LB)						
X AXIS	117.87	1338	115.32	1437	79.58	1393
Y AXIS	34.83	1339	37.42	1435	22.51	1391
Z AXIS	116.32	1339	97.54	1444	52.69	1392
RESULTANT	168.33	1339	153.11	1444	98.77	1393
TOTAL LAP LOAD (LB)	361.46	1339	349.39	1444	226.81	1393
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	1.52	499	30.78	1487	-30.78	1397
X AXIS (RIGHT)	1.19	547	11.72	1496	-40.91	1405
X AXIS (SUM)	2.13	561	39.57	1487	-71.11	1397
Y AXIS (CENTER)	2.74	524	-2.34	1734	-55.67	1406
SEAT LOADS (LB)						
Z AXIS (LEFT)	47.78	493	341.03	1438	19.32	1670
Z AXIS (RIGHT)	53.36	493	442.67	1440	12.30	1261
Z AXIS (CENTER)	296.96	1339	1434.37	1408	162.36	1815
Z AXIS (SUM)	348.98	1339	1950.09	1409	233.18	1220
SEAT Z SUM / WT	2.06	1339	11.54	1409	1.38	1220
RESULTANT SEAT LOAD (LB)	350.31	1339	1951.75	1409	233.59	1220



VERTICAL TEST PHASE      TEST: 698      SUBJ: M-6      WT: 189.0      CELL: F

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1198		
TIME OF IMPACT START				1318		
CARRIAGE ACCELERATION (G)						
X AXIS			1.81	1322	-1.74	1370
Y AXIS			0.29	1498	-0.50	1348
Z AXIS			10.69	1360	-0.13	1202
Z AXIS (SMOOTHED)			9.89	1364	-0.03	1201
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1317	-26.02	1671
TACHOMETER (MEASURED)			-1.13	1676	-26.37	1318
SEAT ACCELERATION (G)						
X AXIS			1.62	1322	-1.67	1366
Y AXIS			1.22	1368	-1.04	1374
Z AXIS			12.25	1360	-0.19	1262
Z AXIS (SMOOTHED)			10.93	1361	-0.11	1200
CHEST ACCELERATION (G)						
X AXIS			2.31	1366	-2.05	1408
Y AXIS			0.70	1464	-2.80	1394
Z AXIS			20.67	1388	-0.59	1312
RESULTANT			20.85	1384	0.22	1505
CHEST SEVERITY INDEX			41.70			
HEAD ACCELERATION (G)						
X AXIS			6.39	1382	-0.26	1318
Y AXIS			2.23	1432	-1.25	1386
Z AXIS			12.07	1374	-0.84	1258
RESULTANT			13.64	1376	0.77	1682
HEAD SEVERITY INDEX			24.02			
NEGATIVE G STRAP	98.11	1304	41.62	1475	-5.45	1362
SHOULDER STRAP LOADS (LB)						
X AXIS	76.84	1305	235.74	1413		
Y AXIS	7.82	1288	20.62	1401		
Z AXIS	3.59	463	59.32	1405		
RESULTANT	77.12	1307	243.28	1413		
LEFT LAP LOADS (LB)						
X AXIS	85.34	1301	106.51	1399	45.47	1361
Y AXIS	26.06	1295	27.83	1399	11.33	1364
Z AXIS	80.10	1296	67.95	1402	16.32	1360
RESULTANT	119.11	1301	128.84	1399	50.24	1361
RIGHT LAP LOADS (LB)						
X AXIS	76.03	1307	113.04	1398	44.12	1350
Y AXIS	19.44	1284	20.74	1395	7.78	1359
Z AXIS	73.70	1304	78.92	1406	15.29	1360
RESULTANT	106.83	1307	139.23	1398	48.16	1362
TOTAL LAP LOAD (LB)	225.03	1305	267.13	1399	98.91	1362
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	5.22	1235	25.33	1417	-6.36	1557
X AXIS (RIGHT)	3.45	609	13.98	1489	-73.16	1376
X AXIS (SUM)	5.62	635	24.80	1472	-67.97	1377
Y AXIS (CENTER)	2.48	1183	1.84	1198	-38.16	1373
SEAT LOADS (LB)						
Z AXIS (LEFT)	55.57	1224	437.74	1390	23.91	1631
Z AXIS (RIGHT)	53.31	1255	532.86	1386	34.76	1194
Z AXIS (CENTER)	166.67	1307	1422.56	1378	94.28	1199
Z AXIS (SUM)	263.73	1305	2361.13	1378	180.42	1194
SEAT Z SUM / WT	1.40	1305	12.49	1378	0.95	1194
RESULTANT SEAT LOAD (LB)	263.96	1305	2362.23	1378	180.47	1194

VERTICAL TEST PHASE	TEST: 672	SUBJ: J-4	WT: 185.0	CELL: F		
PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1240		
TIME OF IMPACT START				1367		
CARRIAGE ACCELERATION (G)						
X AXIS			1.71	1406	-1.52	1410
Y AXIS			0.90	1344	-0.67	1436
Z AXIS			10.47	1400	-0.08	1322
Z AXIS (SMOOTHED)			9.91	1411	-0.02	1262
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1357	-26.23	1696
TACHOMETER (MEASURED)			-1.21	1712	-26.26	1367
SEAT ACCELERATION (G)						
X AXIS			1.55	1402	-1.57	1406
Y AXIS			0.92	1410	-1.02	1362
Z AXIS			11.13	1416	-0.30	1250
Z AXIS (SMOOTHED)			10.43	1416	-0.22	1249
CHEST ACCELERATION (G)						
X AXIS			1.09	1408	-1.54	1434
Y AXIS			0.74	1446	-2.71	1424
Z AXIS			22.77	1422	-1.46	1528
RESULTANT			22.89	1422	0.54	1344
CHEST SEVERITY INDEX			44.98			
HEAD ACCELERATION (G)						
X AXIS			3.86	1420	-1.04	1454
Y AXIS			2.46	1526	0.09	1486
Z AXIS			12.43	1424	-1.35	1496
RESULTANT			12.94	1424	1.12	1656
HEAD SEVERITY INDEX			23.98			
NEGATIVE G STRAP	102.98	1346	54.65	1509	-2.46	1418
SHOULDER STRAP LOADS (LB)						
X AXIS	92.75	771	191.69	1440		
Y AXIS	0.92	805	10.81	1452		
Z AXIS	-3.29	513	15.28	1437		
RESULTANT	93.88	775	192.39	1444		
LEFT LAP LOADS (LB)						
X AXIS	94.08	1341	91.59	1434	47.99	1402
Y AXIS	31.82	1339	26.51	1442	14.72	1407
Z AXIS	98.43	1333	68.06	1433	27.56	1406
RESULTANT	138.98	1341	116.43	1434	59.08	1402
RIGHT LAP LOADS (LB)						
X AXIS	88.41	1336	101.17	1436	55.22	1402
Y AXIS	23.76	1328	20.52	1435	10.80	1405
Z AXIS	92.60	1335	74.87	1435	31.06	1403
RESULTANT	129.13	1336	126.71	1436	64.38	1403
TOTAL LAP LOAD (LB)	266.87	1348	242.95	1434	123.65	1403
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	14.21	1339	24.57	1486	-16.26	1425
X AXIS (RIGHT)	13.03	505	21.80	1472	-20.89	1406
X AXIS (SUM)	19.42	646	40.53	1486	-34.79	1419
Y AXIS (CENTER)	-20.70	564	-21.34	1262	-92.45	1416
SEAT LOADS (LB)						
Z AXIS (LEFT)	88.19	1344	555.12	1424	49.23	1837
Z AXIS (RIGHT)	95.33	1340	543.96	1419	46.30	1671
Z AXIS (CENTER)	222.25	676	1420.17	1419	132.84	1240
Z AXIS (SUM)	399.14	1349	2512.18	1419	263.83	1240
SEAT Z SUM / WT	2.13	1349	13.58	1419	1.43	1240
RESULTANT SEAT LOAD (LB)	394.01	1349	2514.05	1419	265.09	1240

VERTICAL TEST PHASE      TEST: 655      SUBJ: K-1      WT: 182.0      CELL: F

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1180		
TIME OF IMPACT START				1302		
CARRIAGE ACCELERATION (G)						
X AXIS			3.25	1304	-1.97	1310
Y AXIS			0.21	1514	-0.80	1307
Z AXIS			10.41	1341	-0.09	1249
Z AXIS (SMOOTHED)			9.88	1351	-0.03	1243
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1299	-26.13	1635
TACHOMETER (MEASURED)			-1.15	1745	-26.23	1302
SEAT ACCELERATION (G)						
X AXIS			2.62	1303	-1.92	1349
Y AXIS			1.37	1352	-1.09	1317
Z AXIS			11.67	1344	-0.13	1185
Z AXIS (SMOOTHED)			10.79	1342	-0.09	1180
CHEST ACCELERATION (G)						
X AXIS			3.91	1377	-0.33	1464
Y AXIS			0.52	1321	-1.73	1369
Z AXIS			21.00	1370	-0.56	1290
RESULTANT			21.37	1367	0.27	1247
CHEST SEVERITY INDEX			41.66			
HEAD ACCELERATION (G)						
X AXIS			1.71	1359	-2.42	1407
Y AXIS			1.28	1277	0.03	1379
Z AXIS			12.93	1366	-0.84	1194
RESULTANT			13.00	1363	0.71	1611
HEAD SEVERITY INDEX			21.39			
NEGATIVE G STRAP	84.36	1288	20.97	1454	-3.50	1346
SHOULDER STRAP LOADS (LB)						
X AXIS	51.49	1289	169.42	1394		
Y AXIS	5.28	549	2.87	1184		
Z AXIS	3.79	445	35.99	1373		
RESULTANT	51.62	1289	172.03	1394		
LEFT LAP LOADS (LB)						
X AXIS	82.57	1289	68.87	1358	36.48	1342
Y AXIS	25.26	1283	18.19	1367	12.29	1346
Z AXIS	76.03	1275	33.51	1361	10.23	1342
RESULTANT	113.47	1289	77.23	1362	40.01	1342
RIGHT LAP LOADS (LB)						
X AXIS	89.76	1256	59.13	1362	31.04	1343
Y AXIS	22.68	1248	11.02	1349	6.48	1343
Z AXIS	87.18	1253	29.81	1361	5.82	1342
RESULTANT	126.27	1255	66.93	1361	32.45	1343
TOTAL LAP LOAD (LB)	237.82	1264	143.90	1362	72.92	1343
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	3.29	901	19.75	1301	-25.35	1363
X AXIS (RIGHT)	1.89	557	4.23	1301	-52.49	1358
X AXIS (SUM)	3.99	903	23.98	1301	-73.75	1369
Y AXIS (CENTER)	1.51	445	0.24	1306	-28.33	1355
SEAT LOADS (LB)						
Z AXIS (LEFT)	71.18	1245	491.26	1356	22.86	1658
Z AXIS (RIGHT)	94.78	1258	540.47	1358	41.53	1663
Z AXIS (CENTER)	140.36	1285	1357.16	1360	90.27	1186
Z AXIS (SUM)	291.38	1258	2372.74	1359	208.29	1704
SEAT Z SUM / WT	1.60	1258	13.04	1359	1.14	1704
RESULTANT SEAT LOAD (LB)	291.46	1258	2373.88	1359	208.31	1704

VERTICAL TEST PHASE      TEST: 701      SUBJ: M13      WT: 174.0      CELL: F

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1204		
TIME OF IMPACT START				1331		
CARRIAGE ACCELERATION (G)						
X AXIS			1.59	1368	-1.80	1376
Y AXIS			0.75	1382	-0.54	1316
Z AXIS			10.68	1366	-0.07	1232
Z AXIS (SMOOTHED)			9.88	1370	-0.02	1221
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1322	-26.05	1671
TACHOMETER (MEASURED)			-1.15	1701	-26.48	1331
SEAT ACCELERATION (G)						
X AXIS			1.33	1380	-1.59	1372
Y AXIS			1.24	1378	-0.78	1320
Z AXIS			12.04	1370	-0.38	1226
Z AXIS (SMOOTHED)			10.76	1368	-0.22	1223
CHEST ACCELERATION (G)						
X AXIS			1.96	1372	-0.92	1390
Y AXIS			-0.40	1458	-2.03	1392
Z AXIS			19.62	1384	-0.71	1246
RESULTANT			19.69	1384	0.63	1456
CHEST SEVERITY INDEX			35.43			
HEAD ACCELERATION (G)						
X AXIS			2.49	1376	-0.65	1412
Y AXIS			2.07	1426	-0.05	1404
Z AXIS			12.29	1386	-1.14	1266
RESULTANT			12.48	1384	1.27	1635
HEAD SEVERITY INDEX			20.83			
NEGATIVE G STRAP	35.27	1306	15.82	1477	-8.66	1381
SHOULDER STRAP LOADS (LB)						
X AXIS	63.50	1311	148.45	1405		
Y AXIS	6.31	539	8.63	1408		
Z AXIS	0.05	470	24.82	1398		
RESULTANT	63.70	1311	150.18	1405		
LEFT LAP LOADS (LB)						
X AXIS	106.79	1310	135.44	1393	93.08	1346
Y AXIS	29.20	1310	36.27	1400	24.48	1373
Z AXIS	87.74	1304	85.71	1399	52.30	1367
RESULTANT	140.63	1310	163.81	1393	110.44	1368
RIGHT LAP LOADS (LB)						
X AXIS	97.62	1309	121.88	1392	78.48	1359
Y AXIS	27.45	1310	31.34	1395	16.44	1364
Z AXIS	84.00	1306	78.79	1398	40.20	1369
RESULTANT	131.55	1311	147.79	1392	92.57	1369
TOTAL LAP LOAD (LB)	272.18	1312	310.13	1393	203.93	1368
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	60.21	471	36.45	1451	-2.56	1373
X AXIS (RIGHT)	32.69	470	27.43	1469	-6.49	1372
X AXIS (SUM)	92.32	471	60.92	1461	-9.05	1373
Y AXIS (CENTER)	-7.90	951	-11.71	1200	-70.76	1367
SEAT LOADS (LB)						
Z AXIS (LEFT)	66.78	469	510.86	1389	32.59	1281
Z AXIS (RIGHT)	95.51	469	547.55	1392	42.85	1652
Z AXIS (CENTER)	138.56	1312	1351.72	1383	46.97	1204
Z AXIS (SUM)	261.27	469	2332.14	1384	146.28	1226
SEAT Z SUM / WT	1.50	469	13.40	1384	0.84	1226
RESULTANT SEAT LOAD (LB)	277.93	469	2333.01	1384	154.12	1226

## VERTICAL TEST PHASE

TEST: 717

SUBJ: P-3

WT: 208.0

CELL: F

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1290		
TIME OF IMPACT START				1350		
CARRIAGE ACCELERATION (G)						
X AXIS			2.69	1358	-1.76	1360
Y AXIS			1.69	1408	-0.70	1460
Z AXIS			10.56	1391	-0.09	1254
Z AXIS (SMOOTHED)			9.88	1402	-0.03	1314
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1949	-26.10	1663
TACHOMETER (MEASURED)			-1.16	1793	-26.25	1350
SEAT ACCELERATION (G)						
X AXIS			2.26	1358	-1.54	1400
Y AXIS			1.87	1416	-0.90	1448
Z AXIS			12.05	1392	-0.29	1240
Z AXIS (SMOOTHED)			10.79	1392	-0.13	1237
CHEST ACCELERATION (G)						
X AXIS			5.99	1414	-0.49	1360
Y AXIS			-0.04	1604	-2.02	1416
Z AXIS			15.18	1414	-0.76	1506
RESULTANT			16.31	1414	0.36	1349
CHEST SEVERITY INDEX			32.31			
HEAD ACCELERATION (G)						
X AXIS			2.93	1406	-1.12	1452
Y AXIS			1.01	1588	-0.23	1420
Z AXIS			12.96	1412	-0.89	1298
RESULTANT			13.21	1410	0.41	1641
HEAD SEVERITY INDEX			23.19			
NEGATIVE G STRAP	121.55	1339	90.80	1495	16.12	1399
SHOULDER STRAP LOADS (LB)						
X AXIS	73.90	1333	197.83	1443		
Y AXIS	-1.81	604	-1.23	1734		
Z AXIS	-5.03	496	4.88	1408		
RESULTANT	78.58	1333	198.16	1445		
LEFT LAP LOADS (LB)						
X AXIS	131.33	1338	137.56	1424	106.41	1392
Y AXIS	26.11	1334	29.06	1452	17.66	1401
Z AXIS	114.33	1337	108.25	1461	65.73	1391
RESULTANT	175.98	1339	171.53	1448	127.14	1392
RIGHT LAP LOADS (LB)						
X AXIS	127.03	1338	127.03	1451	95.12	1393
Y AXIS	29.62	1336	27.67	1461	17.95	1392
Z AXIS	126.18	1339	116.80	1460	66.73	1393
RESULTANT	180.76	1338	173.74	1460	117.78	1393
TOTAL LAP LOAD (LB)	356.47	1339	343.00	1460	246.33	1392
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	3.27	1309	18.50	1474	-41.22	1413
X AXIS (RIGHT)	4.98	602	7.91	1502	-50.57	1409
X AXIS (SUM)	3.40	930	23.49	1474	-86.21	1405
Y AXIS (CENTER)	7.61	1248	7.61	1248	-25.41	1405
SEAT LOADS (LB)						
Z AXIS (LEFT)	135.75	1329	624.64	1413	73.31	1233
Z AXIS (RIGHT)	83.03	1324	579.20	1413	44.68	1242
Z AXIS (CENTER)	192.77	1339	1490.29	1408	75.64	1230
Z AXIS (SUM)	405.88	1338	2676.05	1408	202.90	1235
SEAT Z SUM / WT	1.95	1338	12.87	1408	0.98	1236
RESULTANT SEAT LOAD (LB)	406.14	1338	2677.35	1408	203.01	1235

VERTICAL TEST PHASE		TEST: 690	SUBJ: A-2	WT: 145.0	CELL: F	
PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1232		
TIME OF IMPACT START				1354		
CARRIAGE ACCELERATION (G)						
X AXIS			1.80	1356	-1.68	1404
Y AXIS			0.99	1564	-0.51	1360
Z AXIS			10.64	1394	-0.08	1268
Z AXIS (SMOOTHED)			9.95	1406	-0.03	1263
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1359	-26.09	1679
TACHOMETER (MEASURED)			-1.74	1725	-26.76	1354
SEAT ACCELERATION (G)						
X AXIS			1.53	1358	-1.55	1404
Y AXIS			1.48	1404	-0.94	1372
Z AXIS			11.92	1398	-0.25	1242
Z AXIS (SMOOTHED)			10.80	1396	-0.13	1242
CHEST ACCELERATION (G)						
X AXIS			2.83	1408	-0.59	1512
Y AXIS			-0.16	1454	-1.57	1410
Z AXIS			18.05	1416	-0.72	1344
RESULTANT			18.20	1413	0.82	1262
CHEST SEVERITY INDEX			31.83			
HEAD ACCELERATION (G)						
X AXIS			1.44	1412	-1.45	1438
Y AXIS			0.82	1502	-0.68	1454
Z AXIS			13.23	1420	-0.54	1282
RESULTANT			13.29	1417	0.34	1317
HEAD SEVERITY INDEX			22.83			
NEGATIVE G STRAP	41.70	1322	8.44	1507	-7.88	1398
SHOULDER STRAP LOADS (LB)						
X AXIS	41.82	1340	106.78	1434		
Y AXIS	4.12	1247	14.59	1420		
Z AXIS	3.54	946	39.45	1412		
RESULTANT	41.98	1341	113.73	1434		
LEFT LAP LOADS (LB)						
X AXIS	89.30	1337	84.31	1412	54.42	1382
Y AXIS	30.59	1340	25.28	1411	16.44	1383
Z AXIS	80.21	1325	46.80	1419	22.50	1395
RESULTANT	123.21	1342	98.20	1417	64.71	1386
RIGHT LAP LOADS (LB)						
X AXIS	70.15	1338	68.88	1417	39.52	1382
Y AXIS	28.35	1314	25.76	1418	14.74	1395
Z AXIS	68.53	1323	38.28	1417	14.29	1395
RESULTANT	101.21	1338	82.70	1417	46.79	1394
TOTAL LAP LOAD (LB)	224.42	1342	180.90	1417	112.47	1396
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	20.65	1315	32.23	1396	1.15	1417
X AXIS (RIGHT)	16.26	604	18.01	1454	3.39	1349
X AXIS (SUM)	30.47	1315	44.98	1396	8.05	1417
Y AXIS (CENTER)	1.13	581	-5.22	1636	-71.26	1409
SEAT LOADS (LB)						
Z AXIS (LEFT)	42.85	1318	407.84	1408	21.69	1233
Z AXIS (RIGHT)	40.37	1341	437.09	1408	14.15	1246
Z AXIS (CENTER)	169.44	1342	1212.56	1413	119.46	1232
Z AXIS (SUM)	249.51	1341	2023.19	1408	156.21	1233
SEAT Z SUM / WT	1.72	1341	13.95	1408	1.09	1233
RESULTANT SEAT LOAD (LB)	251.09	1341	2024.54	1408	160.22	1233

VERTICAL TEST PHASE      TEST: 679      SUBJ: R-3      WT: 156.0      CELL: F

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1182		
TIME OF IMPACT START				1311		
CARRIAGE ACCELERATION (G)						
X AXIS			2.13	1300	-1.44	1352
Y AXIS			0.33	1510	-0.53	1346
Z AXIS			10.57	1342	-0.09	1266
Z AXIS (SMOOTHED)			9.94	1348	-0.03	1240
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.02	1296	-26.23	1649
TACHOMETER (MEASURED)			-1.17	1692	-26.32	1311
SEAT ACCELERATION (G)						
X AXIS			1.74	1302	-1.50	1348
Y AXIS			0.77	1514	-0.76	1510
Z AXIS			11.27	1344	-0.19	1266
Z AXIS (SMOOTHED)			10.68	1345	-0.14	1261
CHEST ACCELERATION (G)						
X AXIS			3.39	1370	-0.26	1451
Y AXIS			0.45	1384	-1.33	1372
Z AXIS			20.36	1370	-0.67	1296
RESULTANT			20.67	1367	0.23	1227
CHEST SEVERITY INDEX			36.39			
HEAD ACCELERATION (G)						
X AXIS			1.32	1362	-2.69	1400
Y AXIS			0.76	1436	-0.07	1382
Z AXIS			13.86	1366	-0.66	1294
RESULTANT			13.92	1363	0.27	1235
HEAD SEVERITY INDEX			22.69			
NEGATIVE G STRAP	66.88	1287	19.81	1454	-6.55	1346
SHOULDER STRAP LOADS (LB)						
X AXIS	53.21	606	172.14	1391		
Y AXIS	7.52	1176	23.22	1385		
Z AXIS	11.22	446	59.51	1374		
RESULTANT	53.58	606	182.60	1384		
LEFT LAP LOADS (LB)						
X AXIS	80.48	1291	86.71	1360	53.07	1336
Y AXIS	24.80	1289	22.44	1368	14.78	1339
Z AXIS	76.70	1291	51.39	1370	27.09	1344
RESULTANT	113.78	1291	101.53	1360	63.99	1344
RIGHT LAP LOADS (LB)						
X AXIS	88.23	1288	97.16	1366	62.70	1322
Y AXIS	32.59	1290	30.64	1369	20.92	1330
Z AXIS	87.72	1287	62.69	1363	33.48	1344
RESULTANT	128.61	1290	118.91	1366	75.55	1344
TOTAL LAP LOAD (LB)	241.52	1291	219.96	1366	139.54	1344
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	-1.63	491	11.77	1400	-18.70	1365
X AXIS (RIGHT)	8.11	1267	12.20	1300	-24.64	1359
X AXIS (SUM)	3.50	1274	22.15	1300	-41.59	1367
Y AXIS (CENTER)	6.86	487	4.95	1209	-26.80	1356
SEAT LOADS (LB)						
Z AXIS (LEFT)	59.10	1286	378.90	1359	24.13	1727
Z AXIS (RIGHT)	85.96	1270	446.35	1359	31.71	1730
Z AXIS (CENTER)	125.73	446	1252.54	1362	70.85	1180
Z AXIS (SUM)	239.41	1287	2063.21	1361	149.13	1181
SEAT Z SUM / WT	1.53	1287	13.23	1361	0.96	1181
RESULTANT SEAT LOAD (LB)	239.42	1287	2063.67	1361	149.18	1181

VERTICAL TEST PHASE	TEST: 678	SUBJ: S-6	WT: 120.0	CELL: F		
PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1230		
TIME OF IMPACT START				1354		
CARRIAGE ACCELERATION (G)						
X AXIS			2.59	1356	-2.06	1402
Y AXIS			0.40	1348	-1.08	1356
Z AXIS			10.74	1392	-0.13	1322
Z AXIS (SMOOTHED)			10.12	1404	-0.03	1252
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.02	1347	-26.29	1702
TACHOMETER (MEASURED)			-1.18	1694	-26.27	1354
SEAT ACCELERATION (G)						
X AXIS			2.09	1358	-1.89	1398
Y AXIS			1.42	1402	-0.98	1460
Z AXIS			12.46	1394	-0.28	1252
Z AXIS (SMOOTHED)			11.25	1395	-0.14	1252
CHEST ACCELERATION (G)						
X AXIS			1.34	1388	-0.89	1430
Y AXIS			0.26	1558	-1.50	1420
Z AXIS			18.12	1410	-0.53	1274
RESULTANT			18.15	1409	0.04	1336
CHEST SEVERITY INDEX			33.10			
HEAD ACCELERATION (G)						
X AXIS			0.72	1401	-1.98	1452
Y AXIS			0.95	1540	-0.43	1404
Z AXIS			11.22	1412	-0.57	1261
RESULTANT			11.22	1412	0.40	1796
HEAD SEVERITY INDEX			18.06			
NEGATIVE G STRAP	39.26	1326	21.06	1504	-7.81	1404
SHOULDER STRAP LOADS (LB)						
X AXIS	53.61	1223	135.56	1409		
Y AXIS	3.43	1201	7.50	1409		
Z AXIS	15.48	1220	69.97	1407		
RESULTANT	55.21	1237	152.17	1409		
LEFT LAP LOADS (LB)						
X AXIS	61.99	1342	78.18	1416	39.57	1381
Y AXIS	25.63	1342	27.98	1421	16.20	1388
Z AXIS	60.44	1340	49.31	1421	21.97	1395
RESULTANT	90.29	1342	94.88	1418	52.84	1361
RIGHT LAP LOADS (LB)						
X AXIS	61.14	1339	81.57	1416	47.10	1378
Y AXIS	19.74	1339	22.98	1418	12.61	1394
Z AXIS	60.37	1338	50.98	1419	22.82	1393
RESULTANT	87.45	1339	97.84	1416	56.52	1394
TOTAL LAP LOAD (LB)	177.43	1342	192.39	1416	110.86	1381
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	18.09	498	33.32	1463	-11.77	1399
X AXIS (RIGHT)	35.51	498	16.21	1353	-16.54	1365
X AXIS (SUM)	53.60	498	36.09	1464	-26.56	1399
Y AXIS (CENTER)	11.95	499	9.41	1739	-28.05	1407
SEAT LOADS (LB)						
Z AXIS (LEFT)	26.40	1227	270.75	1408	7.62	1319
Z AXIS (RIGHT)	26.47	1311	272.71	1408	10.77	1315
Z AXIS (CENTER)	104.22	1337	988.05	1408	69.17	1230
Z AXIS (SUM)	141.81	1342	1531.51	1408	110.22	1234
SEAT Z SUM / WT	1.18	1342	12.76	1408	0.92	1234
RESULTANT SEAT LOAD (LB)	141.84	1342	1531.86	1408	110.96	1234



VERTICAL TEST PHASE      TEST: 663      SUBJ: T-1      WT: 168.0      CELL: F

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1178		
TIME OF IMPACT START				1307		
CARRIAGE ACCELERATION (G)						
X AXIS			1.57	1302	-1.52	1350
Y AXIS			0.26	1396	-0.66	1366
Z AXIS			10.51	1341	-0.14	1264
Z AXIS (SMOOTHED)			9.93	1352	-0.03	1217
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1299	-26.03	1641
TACHOMETER (MEASURED)			-1.21	1671	-26.23	1307
SLAT ACCELERATION (G)						
X AXIS			1.34	1346	-1.83	1350
Y AXIS			1.13	1352	-0.34	1296
Z AXIS			11.28	1358	-0.18	1240
Z AXIS (SMOOTHED)			10.62	1343	-0.08	1176
CHEST ACCELERATION (G)						
X AXIS			1.70	1356	-1.80	1394
Y AXIS			0.35	1398	-1.96	1364
Z AXIS			17.10	1364	-0.56	1170
RESULTANT			17.22	1361	0.31	1214
CHEST SEVERITY INDEX			32.81			
HEAD ACCELERATION (G)						
X AXIS			5.43	1362	-0.25	1386
Y AXIS			1.95	1396	-0.27	1430
Z AXIS			12.97	1364	-0.49	1202
RESULTANT			14.03	1361	0.60	1260
HEAD SEVERITY INDEX			23.29			
NEGATIVE G STRAP	76.09	1182	30.90	1456	-7.38	1346
SHOULDER STRAP LOADS (LB)						
X AXIS	61.14	1289	183.07	1382		
Y AXIS	8.81	1195	16.37	1351		
Z AXIS	6.93	445	44.08	1374		
RESULTANT	61.81	1289	187.92	1382		
LEFT LAP LOADS (LB)						
X AXIS	103.60	1238	79.93	1358	60.00	1343
Y AXIS	33.49	1227	24.65	1367	17.58	1344
Z AXIS	93.87	1239	50.34	1451	30.09	1342
RESULTANT	142.83	1238	93.19	1359	70.02	1343
RIGHT LAP LOADS (LB)						
X AXIS	108.60	1278	84.35	1360	61.37	1343
Y AXIS	28.88	1288	19.81	1360	14.62	1339
Z AXIS	109.07	1275	51.96	1453	34.23	1342
RESULTANT	151.78	1288	100.50	1359	72.28	1343
TOTAL LAP LOAD (LB)	293.54	1282	193.63	1359	142.30	1343
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	6.74	914	93.56	1389	-1.79	1290
X AXIS (RIGHT)	0.69	518	3.61	1420	-37.32	1358
X AXIS (SUM)	3.92	914	22.54	1420	-31.80	1358
Y AXIS (CENTER)	4.56	477	5.19	1717	-15.13	1355
SEAT LOADS (LB)						
Z AXIS (LEFT)	44.52	828	313.79	1357	25.81	1234
Z AXIS (RIGHT)	49.67	1258	389.06	1357	35.84	1264
Z AXIS (CENTER)	221.42	1286	1535.20	1358	141.83	1769
Z AXIS (SUM)	305.27	1287	2237.40	1357	244.55	1768
SEAT Z SUM / WT	1.82	1287	13.32	1357	1.46	1768
RESULTANT SEAT LOAD (LB)	305.28	1287	2237.65	1357	244.70	1768

VERTICAL TEST PHASE      TEST: 699      SUBJ: W-3      WT: 175.0      CELL: F

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1212		
TIME OF IMPACT START				1332		
CARRIAGE ACCELERATION (G)						
X AXIS			1.55	1334	-1.57	1360
Y AXIS			0.39	1396	-0.59	1422
Z AXIS			10.57	1373	-0.11	1222
Z AXIS (SMOOTHED)			9.93	1386	-0.03	1275
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.02	1327	-26.03	1670
TACHOMETER (MEASURED)			-1.12	1779	-26.36	1352
SEAT ACCELERATION (G)						
X AXIS			1.37	1334	-1.45	1380
Y AXIS			1.89	1382	-0.71	1350
Z AXIS			12.47	1374	-0.11	1278
Z AXIS (SMOOTHED)			11.00	1375	-0.08	1236
CHEST ACCELERATION (G)						
X AXIS			1.16	1450	-1.06	1430
Y AXIS			0.26	1478	-2.25	1438
Z AXIS			15.56	1392	-0.91	1244
RESULTANT			15.61	1392	0.17	1469
CHEST SEVERITY INDEX			30.88			
HEAD ACCELERATION (G)						
X AXIS			2.32	1392	-0.34	1426
Y AXIS			2.27	1446	-0.61	1412
Z AXIS			12.65	1398	-0.50	1246
RESULTANT			12.81	1395	0.57	1280
HEAD SEVERITY INDEX			24.49			
NEGATIVE G STRAP	56.92	1313	29.94	1485	-8.35	1387
SHOULDER STRAP LOADS (LB)						
X AXIS	101.08	1307	180.04	1414		
Y AXIS	4.90	1231	6.64	1362		
Z AXIS	2.03	476	30.51	1399		
RESULTANT	101.35	1312	182.40	1414		
LEFT LAP LOADS (LB)						
X AXIS	71.01	1312	82.22	1419	38.62	1375
Y AXIS	23.10	1286	29.59	1417	13.08	1362
Z AXIS	64.74	1302	56.64	1427	13.10	1374
RESULTANT	96.69	1312	102.71	1419	44.60	1375
RIGHT LAP LOADS (LB)						
X AXIS	63.77	1221	68.88	1407	39.52	1359
Y AXIS	21.26	1242	19.96	1408	10.83	1364
Z AXIS	64.10	1232	42.20	1408	15.04	1374
RESULTANT	92.74	1246	82.91	1407	45.17	1374
TOTAL LAP LOAD (LB)	186.67	1304	182.91	1407	89.98	1375
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	34.14	479	30.48	1460	-60.93	1380
X AXIS (RIGHT)	12.66	476	40.73	1384	-7.61	1426
X AXIS (SUM)	46.19	477	30.86	1460	-31.49	1403
Y AXIS (CENTER)	-28.97	572	-34.68	1211	-145.17	1388
SEAT LOADS (LB)						
Z AXIS (LEFT)	34.39	476	474.60	1397	15.51	1306
Z AXIS (RIGHT)	83.44	476	392.52	1398	47.00	1620
Z AXIS (CENTER)	157.87	1321	1361.29	1391	103.37	1212
Z AXIS (SUM)	233.65	1322	2194.75	1391	186.34	1211
SEAT Z SUM / WT	1.34	1322	12.54	1391	1.07	1211
RESULTANT SEAT LOAD (LB)	237.02	1322	2199.40	1391	189.76	1211

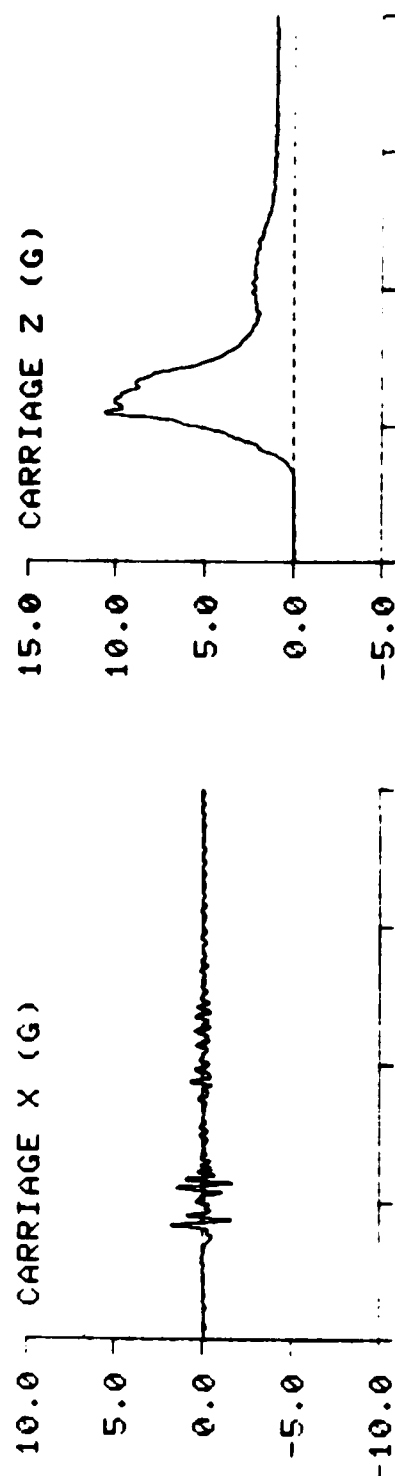
VERTICAL TEST PHASE		TEST: 725	SUBJ: W-4	WT: 191.0	CELL: F	
PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1242		
TIME OF IMPACT START				1366		
CARRIAGE ACCELERATION (G)						
X AXIS			1.72	1406	-1.83	1414
Y AXIS			0.44	1366	-0.51	1446
Z AXIS			10.68	1404	-0.12	1270
Z AXIS (SMOOTHED)			9.90	1408	-0.03	1240
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1360	-26.09	1717
TACHOMETER (MEASURED)			-1.16	1784	-26.34	1366
SEAT ACCELERATION (G)						
X AXIS			1.47	1418	-1.72	1414
Y AXIS			1.74	1412	-0.59	1404
Z AXIS			12.15	1408	-0.06	1256
Z AXIS (SMOOTHED)			11.08	1406	0.01	1257
CHEST ACCELERATION (G)						
X AXIS			1.25	1488	-1.79	1462
Y AXIS			0.70	1426	-2.95	1440
Z AXIS			21.81	1436	-0.98	1266
RESULTANT			21.88	1433	0.43	1365
CHEST SEVERITY INDEX			39.36			
HEAD ACCELERATION (G)						
X AXIS			3.39	1424	-2.15	1470
Y AXIS			0.95	1524	-0.99	1444
Z AXIS			12.71	1424	-0.87	1346
RESULTANT			13.17	1421	0.68	1795
HEAD SEVERITY INDEX			19.97			
NEGATIVE G STRAP	111.64	1352	59.55	1512	16.24	1409
SHOULDER STRAP LOADS (LB)						
X AXIS	52.39	1351	170.32	1457		
Y AXIS	-0.08	555	6.32	1573		
Z AXIS	1.78	506	35.22	1445		
RESULTANT	52.78	1351	173.52	1457		
LEFT LAP LOADS (LB)						
X AXIS	97.10	1352	75.92	1448	48.51	1406
Y AXIS	27.64	1352	18.21	1458	8.19	1413
Z AXIS	95.41	1351	54.92	1471	21.50	1406
RESULTANT	138.21	1352	92.52	1447	54.47	1406
RIGHT LAP LOADS (LB)						
X AXIS	65.48	1349	59.10	1453	24.64	1406
Y AXIS	19.13	1350	14.59	1440	2.93	1407
Z AXIS	73.28	1350	44.08	1460	4.44	1405
RESULTANT	99.29	1350	74.20	1453	25.39	1406
TOTAL LAP LOAD (LB)	236.93	1351	164.94	1447	79.86	1406
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	3.40	977	11.93	1494	-38.04	1435
X AXIS (RIGHT)	4.32	619	11.33	1521	-41.88	1421
X AXIS (SUM)	4.11	593	22.05	1522	-77.54	1420
Y AXIS (CENTER)	3.44	565	-2.27	1240	-52.44	1418
SEAT LOADS (LB)						
Z AXIS (LEFT)	98.70	1348	589.49	1426	40.79	1733
Z AXIS (RIGHT)	52.16	1334	558.52	1448	27.91	1753
Z AXIS (CENTER)	163.43	1352	1282.99	1422	104.39	1240
Z AXIS (SUM)	309.63	1352	2367.31	1423	207.99	1240
SEAT Z SUM / WT	1.62	1352	12.39	1423	1.09	1240
RESULTANT SEAT LOAD (LB)	310.01	1352	2368.94	1423	208.05	1240

RESTRAINT CONFIGURATION STUDY

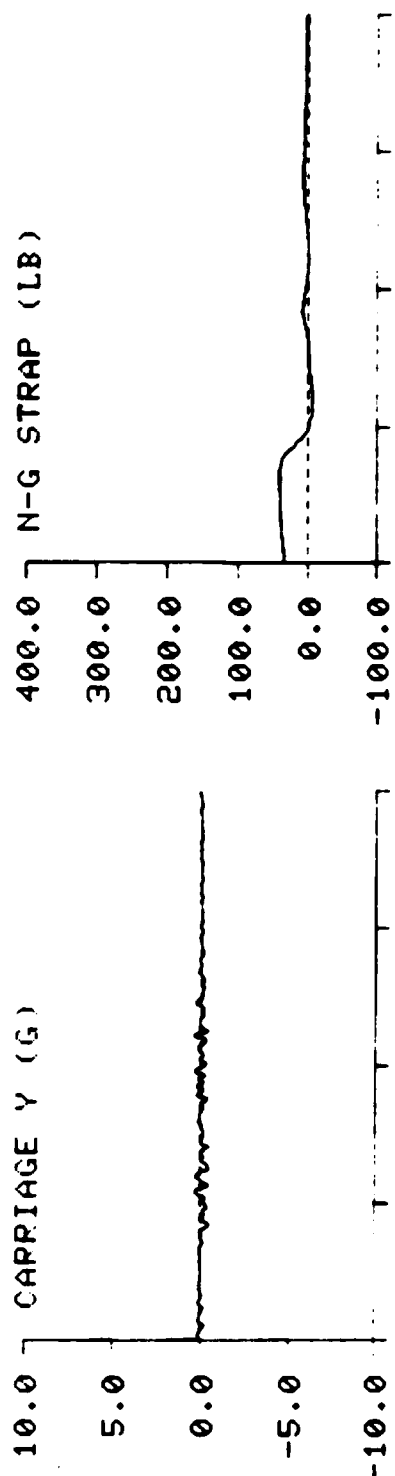
TEST NO: 690

SUBJ ID: R-2

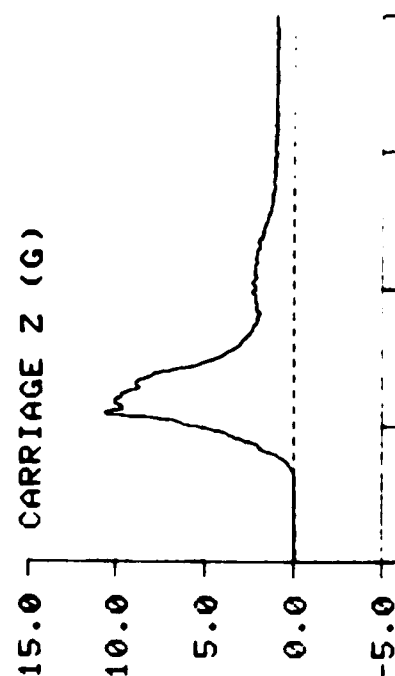
CARRIAGE X (G)



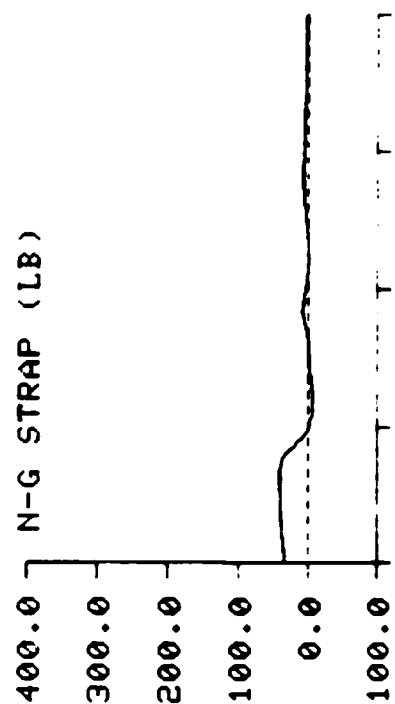
CARRIAGE Y (G)



CARRIAGE Z (G)



N-G STRAP (LB)

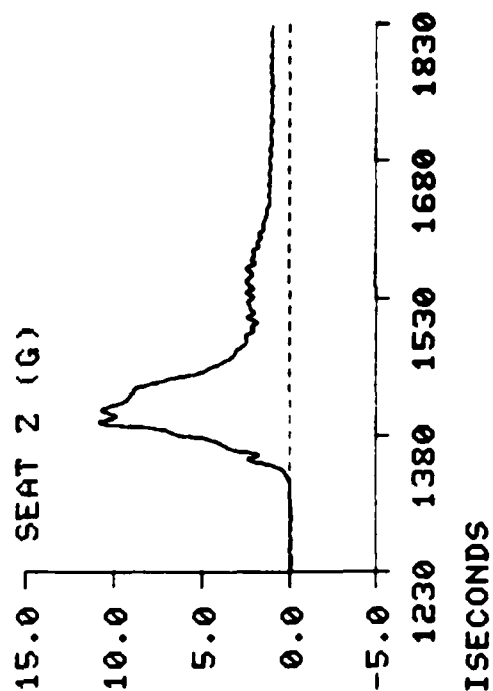
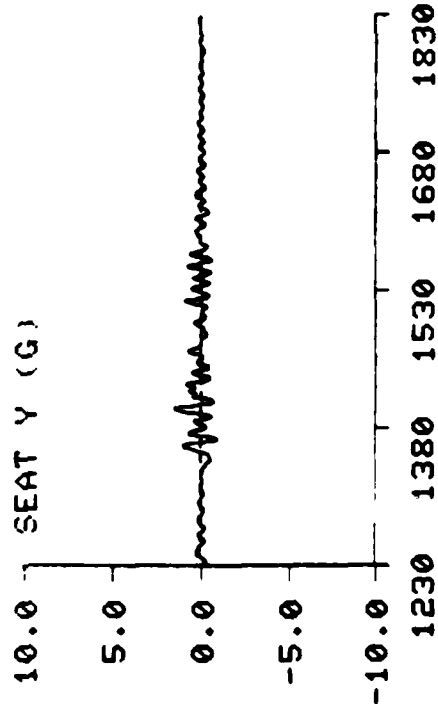
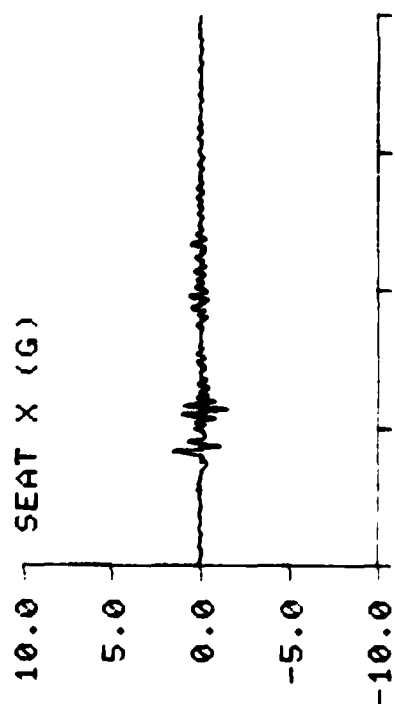


TIME IN MILLISECONDS

RESTRAINT CONFIGURATION STUDY

TEST NO: 690

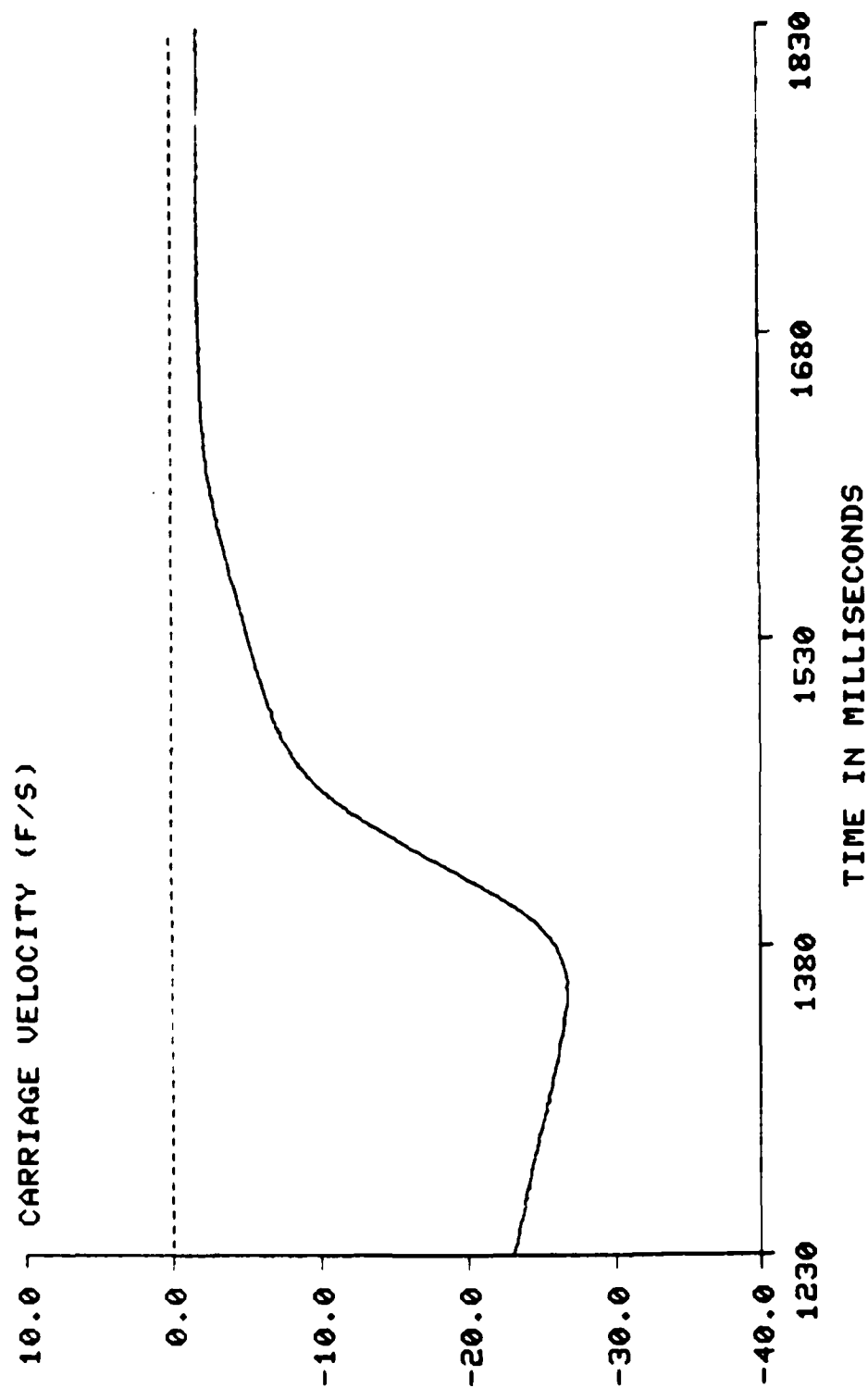
SUBJ ID: R-2



SUBJ ID: R-2

TEST NO: 690

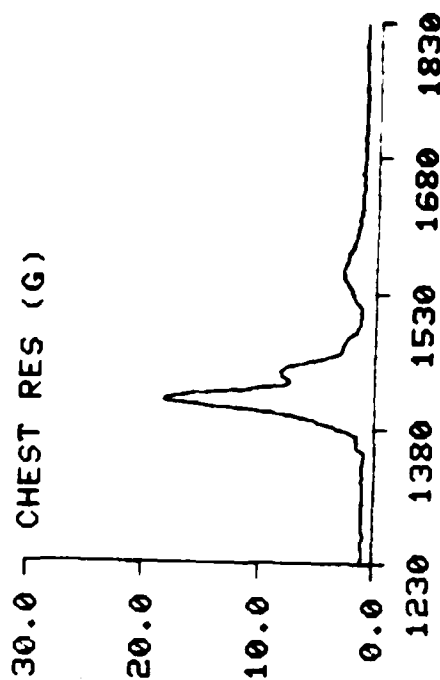
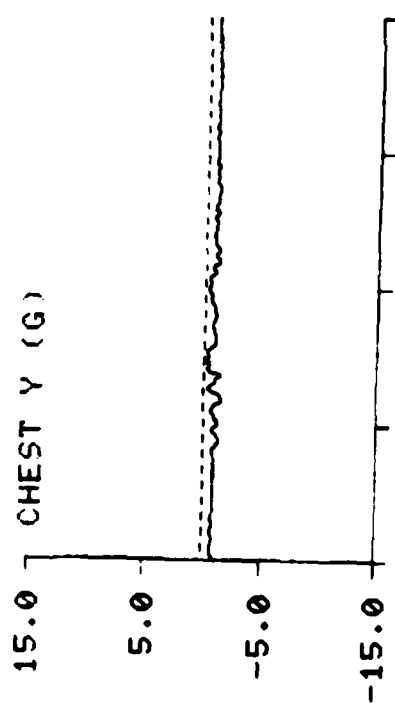
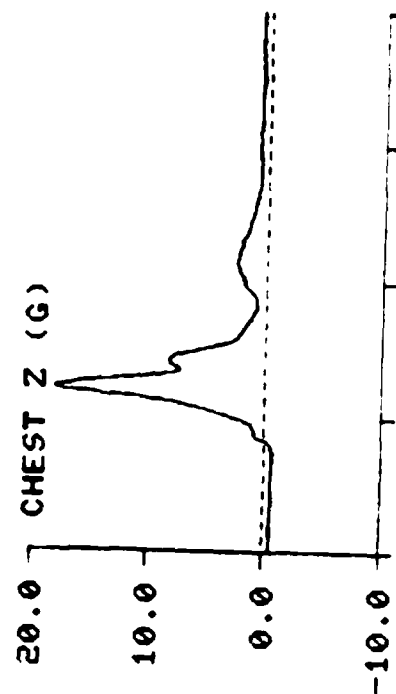
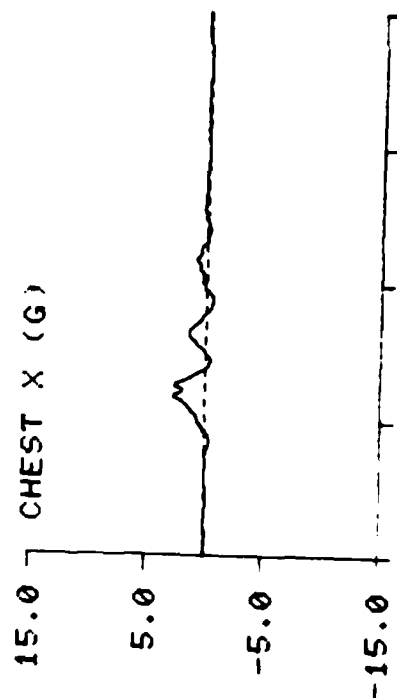
RESTRAINT CONFIGURATION STUDY



RESTRAINT CONFIGURATION STUDY

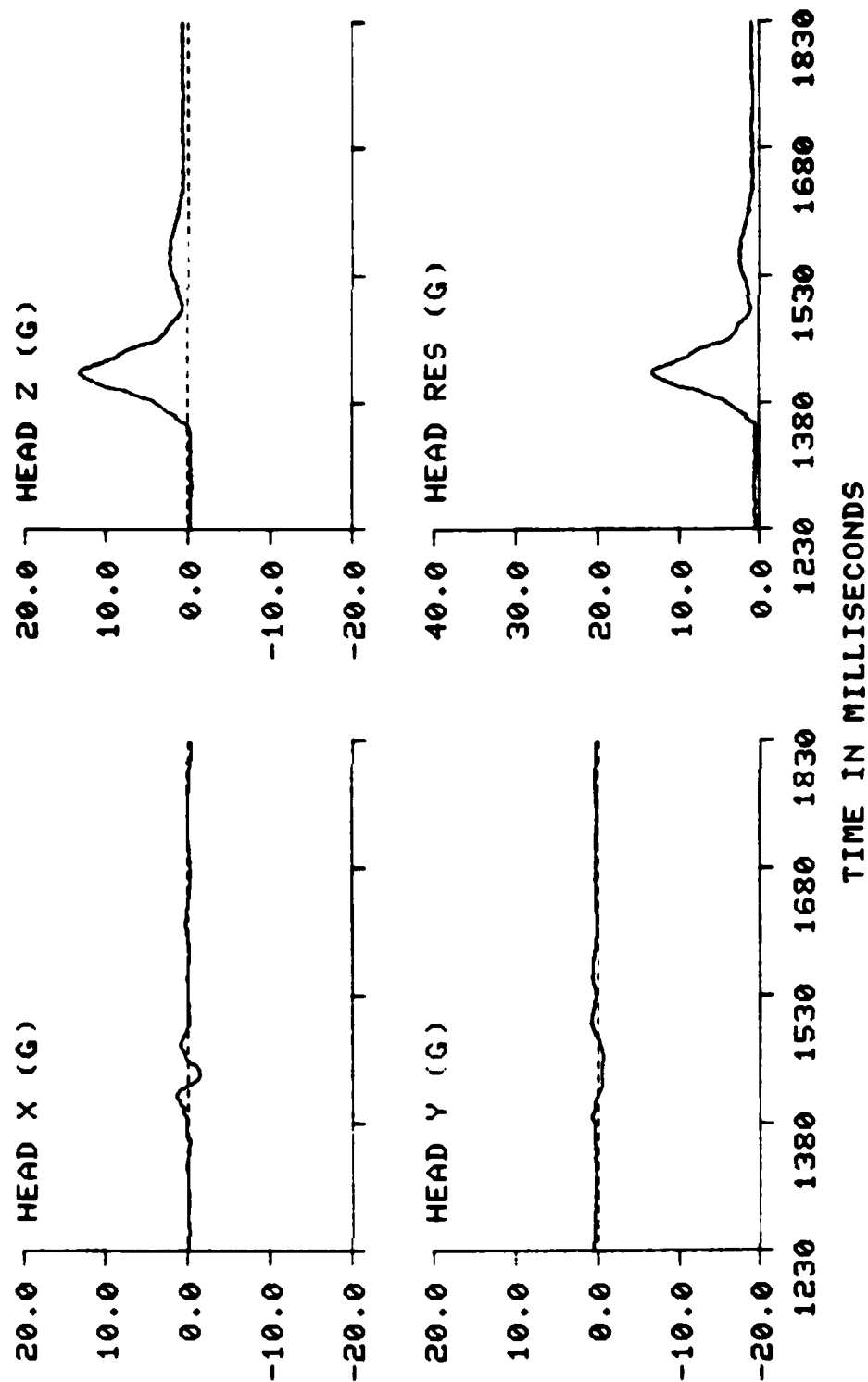
TEST NO: 690

SUBJ ID: R-2



TIME IN MILLISECONDS

RESTRAINT CONFIGURATION STUDY      TEST NO: 690      SUBJ ID: R-2

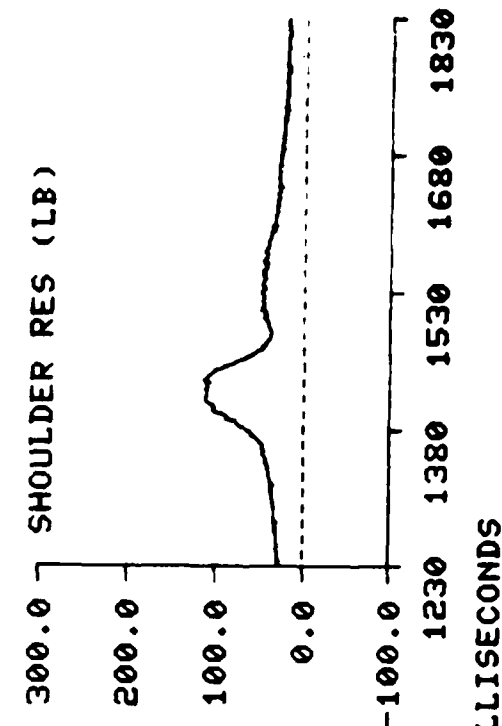
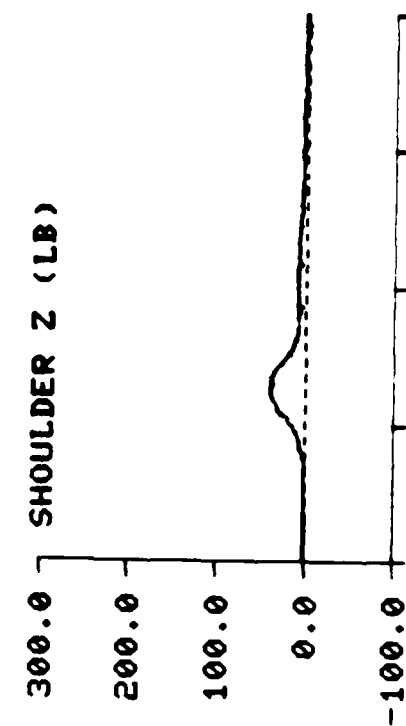
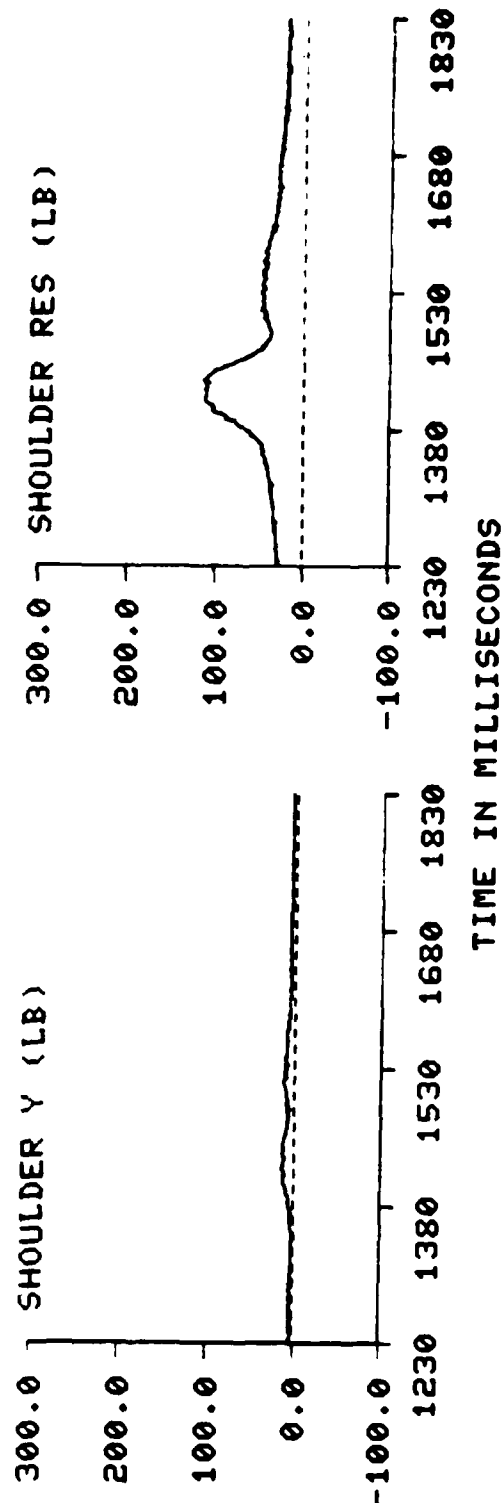
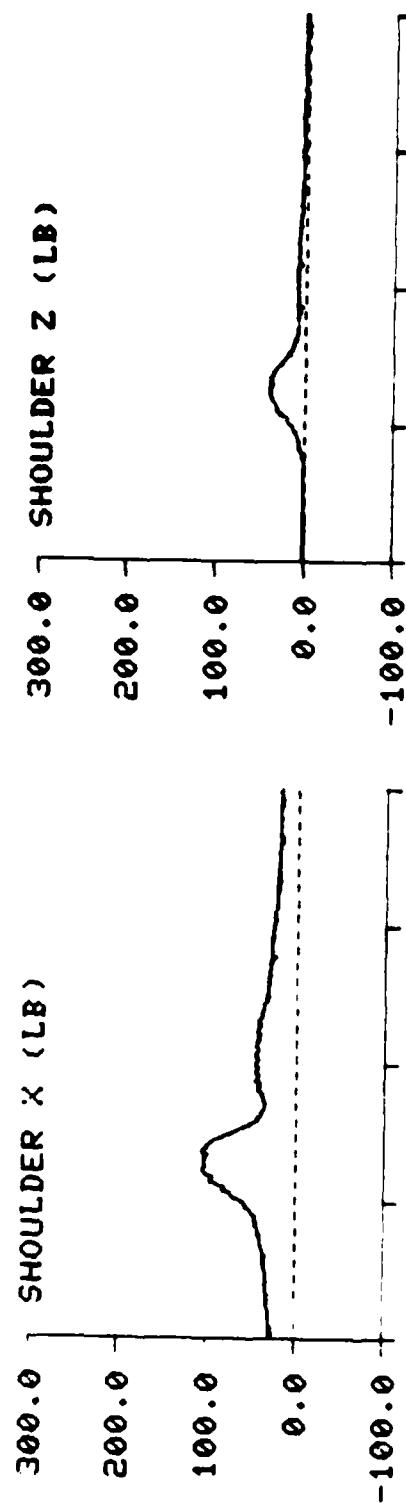




# RESTRAINT CONFIGURATION STUDY

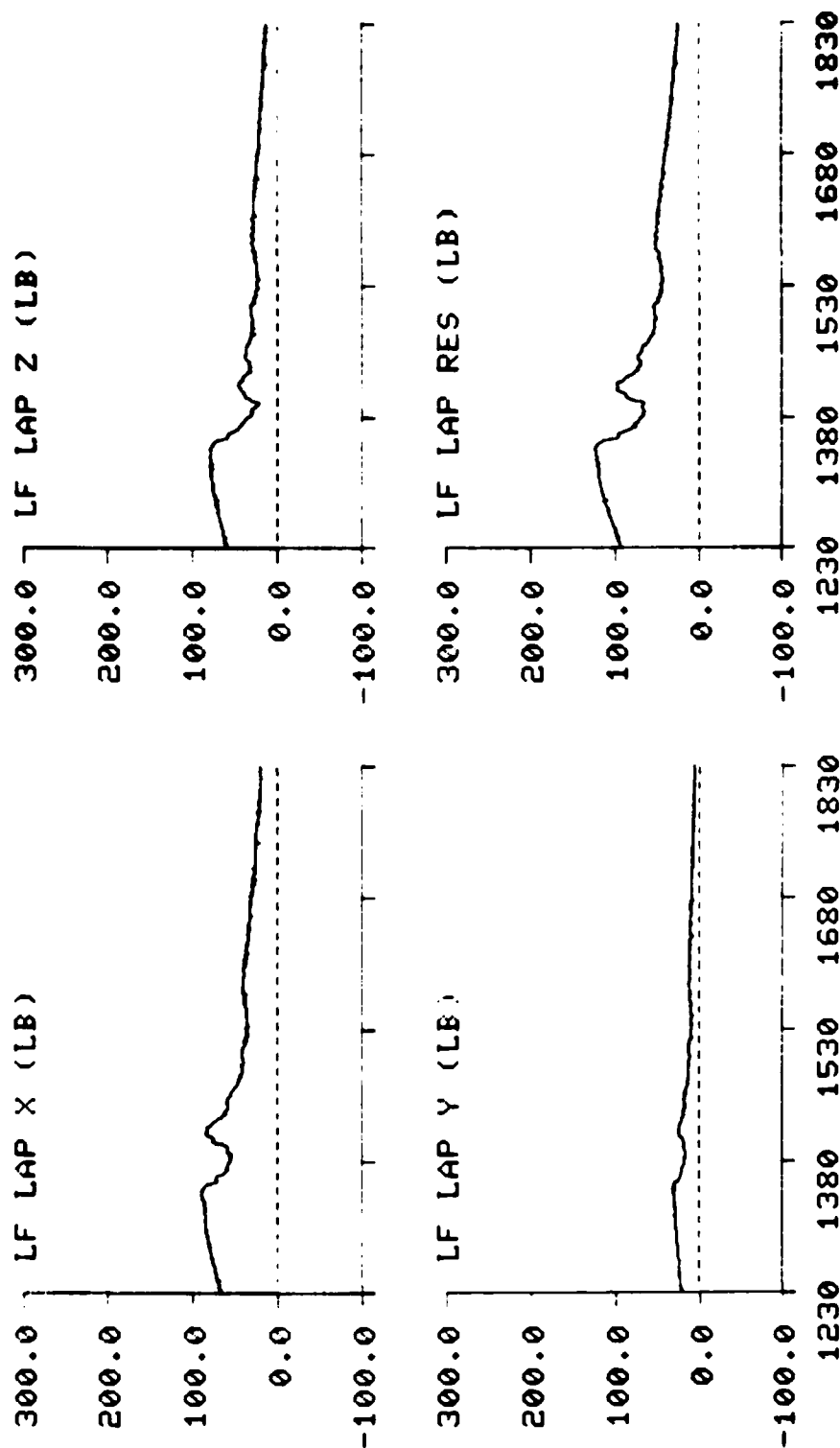
TEST NO: 690

SUBJ ID: R-2



TIME IN MILLISECONDS

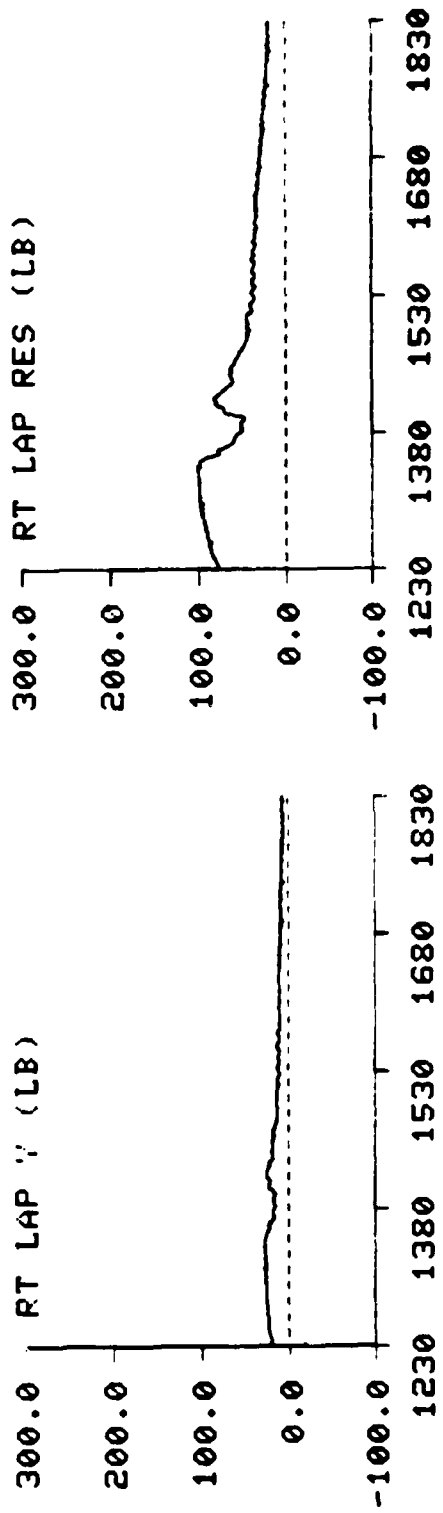
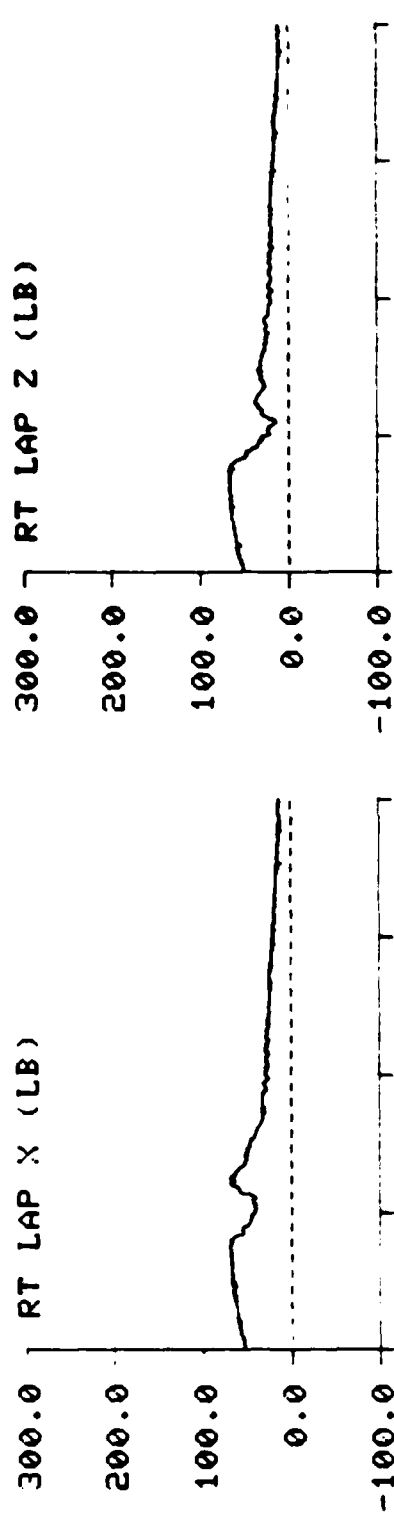
RESTRAINT CONFIGURATION STUDY      TEST NO: 690      SUBJ ID: R-2



SUBJ ID: R-2

TEST NO: 690

RESTRAINT CONFIGURATION STUDY

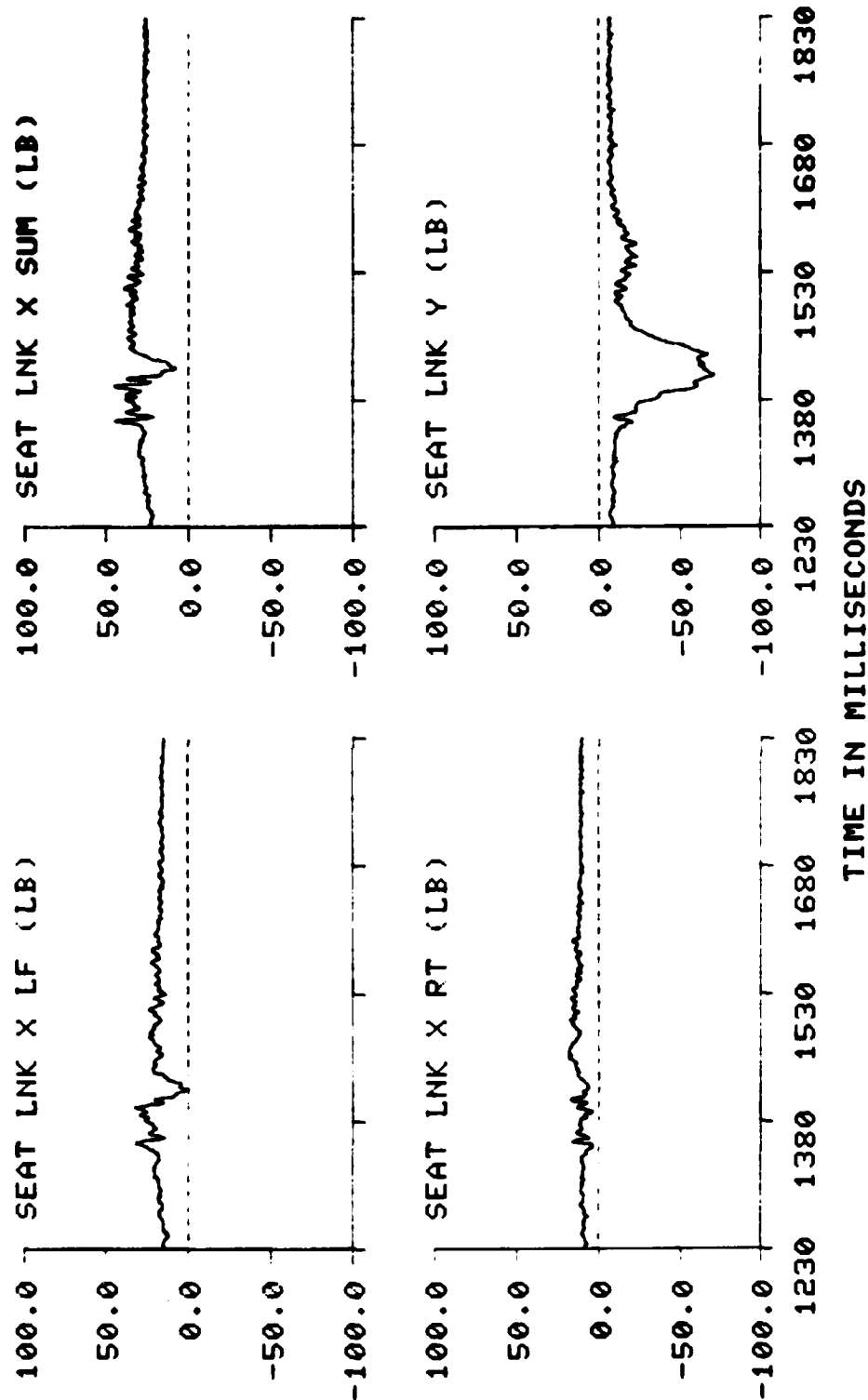


TIME IN MILLISECONDS

# RESTRAINT CONFIGURATION STUDY

TEST NO: 690

SUBJ ID: R-2

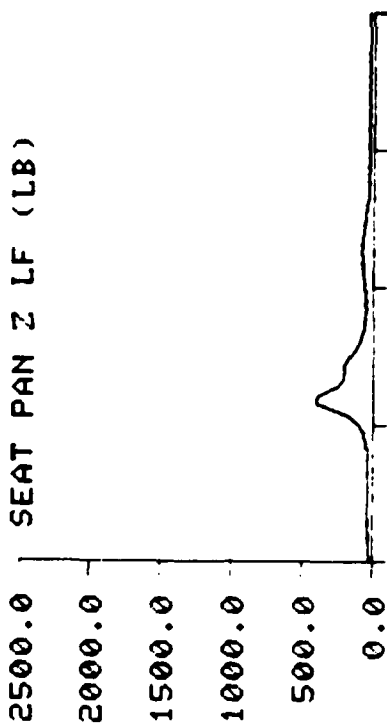


# RESTRAINT CONFIGURATION STUDY

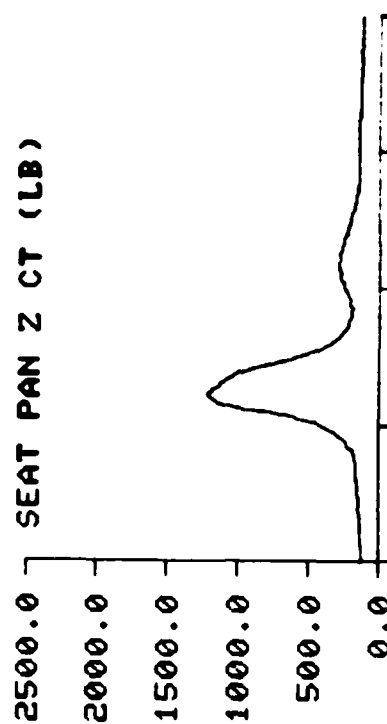
TEST NO: 690

SUBJ ID: R-2

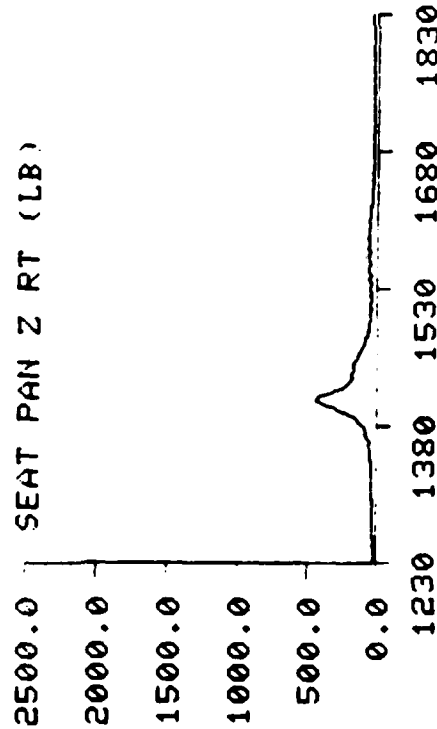
SEAT PAN Z LF (LB)



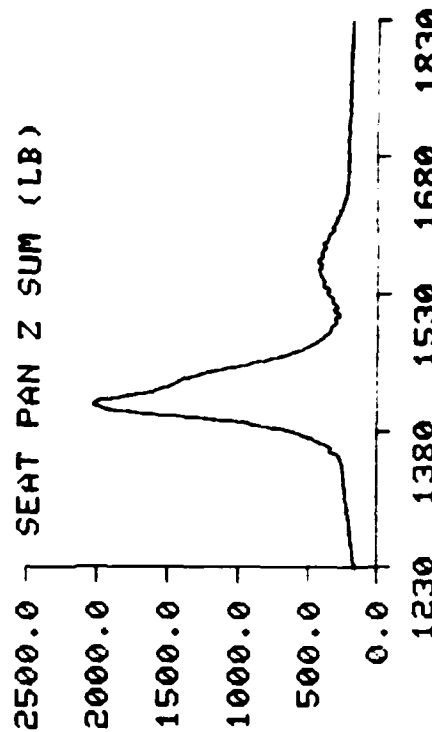
SEAT PAN Z CT (LB)



SEAT PAN Z RT (LB)



SEAT PAN Z SUM (LB)



TIME IN MILLISECONDS

VERTICAL TEST PHASE      TEST: 718      SUBJ: B-2      WT: 190.0      CELL: G

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1224		
TIME OF IMPACT START				1353		
CARRIAGE ACCELERATION (G)						
X AXIS			1.43	1392	-1.70	1394
Y AXIS			1.39	1398	-0.53	1392
Z AXIS			10.78	1386	-0.11	1292
Z AXIS (SMOOTHED)			8.97	1381	-0.03	1288
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1342	-26.21	1694
TACHOMETER (MEASURED)			-1.16	1721	-26.30	1353
SEAT ACCELERATION (G)						
X AXIS			1.17	1398	-1.68	1396
Y AXIS			1.38	1404	-0.82	1442
Z AXIS			11.93	1390	-0.14	1270
Z AXIS (SMOOTHED)			10.96	1388	-0.09	1257
CHEST ACCELERATION (G)						
X AXIS			3.86	1402	-0.04	1488
Y AXIS			0.17	1420	-2.84	1406
Z AXIS			17.08	1408	-0.93	1304
RESULTANT			17.58	1407	0.59	1353
CHEST SEVERITY INDEX			32.49			
HEAD ACCELERATION (G)						
X AXIS			3.38	1402	-2.07	1472
Y AXIS			0.41	1296	-1.84	1454
Z AXIS			13.29	1404	-0.41	1232
RESULTANT			13.79	1401	0.34	1230
HEAD SEVERITY INDEX			22.07			
SHOULDER STRAP LOADS (LB)						
X AXIS	70.74	1395	111.72	1415	66.74	1367
Y AXIS	8.81	615	17.86	1430		
Z AXIS	0.79	659	24.32	1423		
RESULTANT	71.23	1335	114.89	1415	67.01	1367
LEFT LAP LOADS (LB)						
X AXIS	88.28	1305	80.03	1414	53.87	1375
Y AXIS	23.94	1314	10.97	1503	5.67	1395
Z AXIS	96.16	1319	54.65	1414	32.38	1387
RESULTANT	131.27	1319	97.40	1414	64.50	1389
RIGHT LAP LOADS (LB)						
X AXIS	70.82	1289	73.37	1415	45.29	1388
Y AXIS	20.12	1285	17.52	1420	6.51	1387
Z AXIS	86.36	1310	57.16	1414	25.87	1387
RESULTANT	112.58	1311	94.20	1414	54.17	1388
TOTAL LAP LOAD (LB)	243.22	1318	191.60	1414	118.75	1388
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	4.92	969	10.41	1519	-60.29	1404
X AXIS (RIGHT)	-2.26	594	11.78	1419	-54.30	1394
X AXIS (SUM)	-2.60	969	5.20	1422	-98.75	1403
Y AXIS (CENTER)	-1.87	858	-5.68	1669	-76.16	1409
SEAT LOADS (LB)						
Z AXIS (LEFT)	45.41	488	795.16	1421	4.09	1312
Z AXIS (RIGHT)	54.97	488	638.81	1420	21.14	1306
Z AXIS (CENTER)	182.24	1335	1549.94	1403	133.31	1818
Z AXIS (SUM)	244.25	488	2584.19	1419	179.65	1227
SEAT Z SUM / WT	1.29	488	13.60	1419	0.95	1227
RESULTANT SEAT LOAD (LB)	244.69	488	2584.93	1418	180.28	1227

VERTICAL TEST PHASE      TEST: 676      SUBJ: B-1      WT: 152.0      CELL: G

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1202		
TIME OF IMPACT START				1321		
CARRIAGE ACCELERATION (G)						
X AXIS			1.87	1366	-1.66	1370
Y AXIS			0.28	1534	-0.66	1414
Z AXIS			10.39	1364	-0.06	1288
Z AXIS (SMOOTHED)			9.92	1375	-0.02	1217
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.02	1318	-26.14	1648
TACHOMETER (MEASURED)			-0.64	1677	-25.94	1321
SEAT ACCELERATION (G)						
X AXIS			1.69	1368	-1.57	1370
Y AXIS			0.69	1376	-0.62	1450
Z AXIS			11.01	1368	-0.22	1230
Z AXIS (SMOOTHED)			10.52	1366	-0.16	1228
CHEST ACCELERATION (G)						
X AXIS			2.43	1378	-0.15	1325
Y AXIS			1.26	1420	-0.55	1782
Z AXIS			16.25	1376	-0.68	1236
RESULTANT			16.43	1376	0.53	1281
CHEST SEVERITY INDEX			30.04			
HEAD ACCELERATION (G)						
X AXIS			1.14	1384	-2.77	1406
Y AXIS			1.24	1474	-0.63	1398
Z AXIS			14.34	1382	-0.46	1256
RESULTANT			14.37	1379	0.29	1305
HEAD SEVERITY INDEX			23.84			
SHOULDER STRAP LOADS (LB)						
X AXIS	62.16	1298	73.16	1391	51.17	1352
Y AXIS	2.86	468	19.15	1394		
Z AXIS	4.53	1034	30.54	1375		
RESULTANT	62.35	1304	80.20	1396	53.52	1352
LEFT LAP LOADS (LB)						
X AXIS	81.42	1310	73.95	1389	49.03	1366
Y AXIS	30.08	1306	24.19	1390	16.53	1360
Z AXIS	83.87	1298	56.54	1472	27.17	1365
RESULTANT	119.86	1310	91.50	1389	58.45	1366
RIGHT LAP LOADS (LB)						
X AXIS	75.41	1278	75.41	1389	48.61	1365
Y AXIS	34.83	1297	30.29	1392	19.92	1359
Z AXIS	81.48	1284	62.71	1465	27.24	1365
RESULTANT	116.17	1303	96.63	1388	59.86	1365
TOTAL LAP LOAD (LB)	235.06	1303	187.75	1388	118.55	1366
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	7.58	842	21.60	1415	-14.36	1369
X AXIS (RIGHT)	14.77	467	5.42	1450	-32.60	1379
X AXIS (SUM)	13.85	469	21.12	1423	-45.20	1370
Y AXIS (CENTER)	-2.02	964	-4.56	1200	-69.33	1378
SEAT LOADS (LB)						
Z AXIS (LEFT)	41.28	1305	344.24	1411	28.24	1211
Z AXIS (RIGHT)	55.44	1312	463.01	1381	32.67	1223
Z AXIS (CENTER)	114.73	467	1194.35	1381	67.18	1201
Z AXIS (SUM)	187.65	467	1972.80	1380	133.35	1202
SEAT Z SUM / WT	1.23	467	12.98	1380	0.88	1202
RESULTANT SEAT LOAD (LB)	188.60	467	1974.40	1380	133.50	1202

VERTICAL TEST PHASE      TEST: 695      SUBJ: B-3      WT: 178.0      CELL: G

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1230		
TIME OF IMPACT START				1357		
CARRIAGE ACCELERATION (G)						
X AXIS			2.05	1398	-2.13	1402
Y AXIS			0.78	1396	-0.72	1362
Z AXIS			10.65	1392	-0.07	1290
Z AXIS (SMOOTHED)			10.02	1404	-0.03	1274
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1350	-26.13	1661
TACHOMETER (MEASURED)			-1.12	1813	-26.39	1357
SEAT ACCELERATION (G)						
X AXIS			1.63	1358	-2.10	1402
Y AXIS			1.92	1402	-1.52	1370
Z AXIS			12.25	1394	-0.40	1244
Z AXIS (SMOOTHED)			10.96	1394	-0.25	1244
CHEST ACCELERATION (G)						
X AXIS			4.00	1416	-0.33	1452
Y AXIS			-0.45	1358	-3.43	1412
Z AXIS			14.35	1414	-0.68	1248
RESULTANT			15.20	1414	0.68	1350
CHEST SEVERITY INDEX			27.26			
HEAD ACCELERATION (G)						
X AXIS			4.03	1408	-0.10	1505
Y AXIS			1.03	1384	-0.23	1478
Z AXIS			12.04	1404	-0.76	1252
RESULTANT			12.70	1404	0.12	1353
HEAD SEVERITY INDEX			21.50			
SHOULDER STRAP LOADS (LB)						
X AXIS	107.60	1334	149.57	1439	94.61	1372
Y AXIS	11.80	1208	24.01	1410		
Z AXIS	4.51	650	37.94	1423		
RESULTANT	108.14	1336	154.94	1439	95.61	1374
LEFT LAP LOADS (LB)						
X AXIS	127.34	1246	97.44	1420	61.32	1396
Y AXIS	61.46	1284	42.01	1419	28.46	1396
Z AXIS	147.15	1282	78.31	1419	45.90	1393
RESULTANT	203.35	1290	131.28	1420	82.28	1396
RIGHT LAP LOADS (LB)						
X AXIS	109.42	1227	92.82	1424	54.53	1395
Y AXIS	38.02	1226	28.94	1428	15.98	1395
Z AXIS	133.57	1248	76.20	1417	39.70	1394
RESULTANT	176.01	1232	123.39	1418	69.32	1395
TOTAL LAP LOAD (LB)	378.73	1246	253.97	1418	152.17	1395
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	42.44	495	40.00	1449	-5.70	1416
X AXIS (RIGHT)	19.56	495	23.65	1430	-14.95	1389
X AXIS (SUM)	62.00	495	52.95	1441	-19.43	1399
Y AXIS (CENTER)	-26.77	588	-26.14	1640	-108.05	1408
SEAT LOADS (LB)						
Z AXIS (LEFT)	52.40	495	449.09	1437	12.24	1347
Z AXIS (RIGHT)	77.96	495	526.16	1435	21.39	1340
Z AXIS (CENTER)	244.88	1305	1537.86	1410	164.94	1821
Z AXIS (SUM)	308.56	1269	2093.90	1413	238.73	1726
SEAT Z SUM / WT	1.73	1269	11.76	1413	1.34	1726
RESULTANT SEAT LOAD (LB)	312.08	1269	2096.53	1413	241.77	1726



VERTICAL TEST PHASE      TEST: 708      SUBJ: C-1      WT: 170.0      CELL: G

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1246		
TIME OF IMPACT START				1367		
CARRIAGE ACCELERATION (G)						
X AXIS			1.84	1410	-2.08	1418
Y AXIS			1.13	1424	-0.74	1376
Z AXIS			10.71	1407	-0.14	1284
Z AXIS (SMOOTHED)			9.86	1412	-0.04	1281
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.02	1363	-26.24	1737
TACHOMETER (MEASURED)			-1.16	1716	-26.27	1367
SEAT ACCELERATION (G)						
X AXIS			1.56	1418	-2.08	1414
Y AXIS			1.28	1420	-0.90	1464
Z AXIS			11.71	1412	-0.29	1242
Z AXIS (SMOOTHED)			10.74	1409	-0.21	1240
CHEST ACCELERATION (G)						
X AXIS			3.00	1416	-0.62	1474
Y AXIS			1.18	1500	-1.52	1436
Z AXIS			17.40	1426	-0.68	1348
RESULTANT			17.59	1426	0.29	1368
CHEST SEVERITY INDEX			32.64			
HEAD ACCELERATION (G)						
X AXIS			4.36	1434	-1.30	1498
Y AXIS			1.08	1512	-1.99	1450
Z AXIS			12.89	1438	1.11	1350
RESULTANT			13.70	1432	1.51	1342
HEAD SEVERITY INDEX			34.51			
SHOULDER STRAP LOADS (LB)						
X AXIS	140.32	1345	199.28	1457	112.33	1410
Y AXIS	3.84	1291	12.56	1460		
Z AXIS	-0.37	607	29.35	1443		
RESULTANT	140.93	1349	201.22	1457	113.86	1410
LEFT LAP LOADS (LB)						
X AXIS	156.74	1349	126.85	1442	78.26	1411
Y AXIS	73.36	1350	52.14	1463	34.46	1413
Z AXIS	183.27	1348	116.45	1473	67.85	1411
RESULTANT	251.73	1349	176.34	1441	109.54	1411
RIGHT LAP LOADS (LB)						
X AXIS	139.59	1351	116.62	1440	70.67	1410
Y AXIS	54.89	1342	40.63	1446	23.14	1411
Z AXIS	174.06	1350	109.39	1471	59.33	1410
RESULTANT	229.00	1350	162.60	1440	95.45	1410
TOTAL LAP LOAD (LB)	480.34	1350	338.30	1440	205.61	1411
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	22.51	513	26.78	1494	-6.74	1423
X AXIS (RIGHT)	57.91	510	16.97	1480	-12.85	1414
X AXIS (SUM)	79.25	513	39.58	1488	-18.42	1423
Y AXIS (CENTER)	105.77	511	61.33	1752	15.61	1408
SEAT LOADS (LB)						
Z AXIS (LEFT)	47.78	1233	378.63	1437	36.93	1642
Z AXIS (RIGHT)	56.61	1354	444.27	1433	37.04	1245
Z AXIS (CENTER)	300.23	1354	1381.10	1424	190.80	1839
Z AXIS (SUM)	400.67	1354	2168.48	1425	277.46	1839
SEAT Z SUM / WT	2.36	1354	12.76	1425	1.63	1839
RESULTANT SEAT LOAD (LB)	403.62	1354	2168.66	1425	285.03	1839

VERTICAL TEST PHASE		TEST: 653	SUBJ: C-2	WT: 177.0	CELL: G	
PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1224		
TIME OF IMPACT START				1347		
CARRIAGE ACCELERATION (G)						
X AXIS			1.92	1348	-1.56	1395
Y AXIS			0.43	1347	-0.67	1396
Z AXIS			10.56	1386	-0.12	1314
Z AXIS (SMOOTHED)			10.01	1397	-0.03	1261
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1344	-26.14	1691
TACHOMETER (MEASURED)			-1.18	1761	-26.23	1347
SEAT ACCELERATION (G)						
X AXIS			1.62	1348	-1.70	1395
Y AXIS			1.16	1398	-0.84	1344
Z AXIS			11.47	1404	-0.19	1224
Z AXIS (SMOOTHED)			10.80	1388	-0.13	1220
CHEST ACCELERATION (G)						
X AXIS			1.98	1404	-0.88	1429
Y AXIS			0.91	1501	-1.46	1402
Z AXIS			15.48	1408	-0.69	1283
RESULTANT			15.64	1403	0.33	1342
CHEST SEVERITY INDEX			27.29			
HEAD ACCELERATION (G)						
X AXIS			2.37	1400	-1.14	1456
Y AXIS			1.79	1431	0.43	1546
Z AXIS			10.95	1409	-0.56	1331
RESULTANT			11.14	1405	0.84	1757
HEAD SEVERITY INDEX			21.07			
SHOULDER STRAP LOADS (LB)						
X AXIS	58.59	1334	184.51	1432	62.58	1366
Y AXIS	3.20	1208	9.60	1408		
Z AXIS	6.64	1324	49.98	1422		
RESULTANT	58.79	1334	190.63	1430	64.29	1366
LEFT LAP LOADS (LB)						
X AXIS	80.25	1330	126.35	1422	60.32	1373
Y AXIS	32.98	1329	45.36	1425	24.73	1378
Z AXIS	87.92	1331	106.14	1421	50.46	1385
RESULTANT	122.81	1333	170.51	1422	88.82	1373
RIGHT LAP LOADS (LB)						
X AXIS	76.79	1332	113.81	1421	56.37	1388
Y AXIS	28.27	1331	40.58	1422	17.25	1369
Z AXIS	90.83	1333	102.30	1420	40.76	1387
RESULTANT	121.31	1333	157.32	1421	74.52	1387
TOTAL LAP LOAD (LB)	244.11	1333	327.38	1421	163.93	1388
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	0.90	967	14.31	1472	-26.52	1412
X AXIS (RIGHT)	1.32	822	5.42	1482	-34.94	1392
X AXIS (SUM)	-0.16	571	17.97	1472	-55.36	1392
Y AXIS (CENTER)	8.99	497	0.10	1222	-31.01	1400
SEAT LOADS (LB)						
Z AXIS (LEFT)	42.01	489	406.77	1416	11.55	1335
Z AXIS (RIGHT)	42.22	490	426.25	1410	19.71	1253
Z AXIS (CENTER)	151.20	1334	1359.94	1404	61.53	1223
Z AXIS (SUM)	200.02	1334	2126.11	1405	108.06	1224
SEAT Z SUM / WT	1.13	1334	12.01	1405	0.61	1224
RESULTANT SEAT LOAD (LB)	200.52	1334	2126.79	1405	108.14	1224

VERTICAL TEST PHASE      TEST: 640      SUBJ: E-2      WT: 168.0      CELL: G

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1180		
TIME OF IMPACT START				1312		
CARRIAGE ACCELERATION (G)						
X AXIS			3.05	1320	-2.68	1326
Y AXIS			0.95	1376	-0.83	1324
Z AXIS			10.67	1354	-0.08	1286
Z AXIS (SMOOTHED)			10.03	1365	-0.02	1282
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1311	-26.29	1662
TACHOMETER (MEASURED)			-1.16	1690	-26.06	1312
SEAT ACCELERATION (G)						
X AXIS			2.90	1320	-2.02	1363
Y AXIS			1.48	1367	-1.23	1335
Z AXIS			12.55	1359	-0.20	1209
Z AXIS (SMOOTHED)			11.15	1356	-0.10	1205
CHEST ACCELERATION (G)						
X AXIS			2.55	1366	-0.71	1396
Y AXIS			1.44	1338	-1.62	1380
Z AXIS			15.12	1379	-0.63	1213
RESULTANT			15.32	1376	0.50	1261
CHEST SEVERITY INDEX			29.99			
HEAD ACCELERATION (G)						
X AXIS			2.80	1367	-0.64	1448
Y AXIS			1.91	1380	-0.25	1415
Z AXIS			11.82	1367	-0.75	1197
RESULTANT			12.21	1364	0.60	1471
HEAD SEVERITY INDEX			20.43			
SHOULDER STRAP LOADS (LB)						
X AXIS	109.80	1300	246.72	1394	108.80	1334
Y AXIS	7.82	1208	8.78	1343		
Z AXIS	6.56	642	57.33	1394		
RESULTANT	110.06	1302	253.29	1394	109.51	1334
LEFT LAP LOADS (LB)						
X AXIS	91.79	706	112.97	1388	88.12	1347
Y AXIS	41.80	691	46.51	1411	28.83	1349
Z AXIS	101.16	719	104.20	1417	48.52	1356
RESULTANT	141.33	700	159.53	1408	89.26	1356
RIGHT LAP LOADS (LB)						
X AXIS	78.07	690	99.77	1408	57.65	1335
Y AXIS	33.18	691	41.61	1403	20.22	1356
Z AXIS	93.52	699	98.73	1409	41.37	1357
RESULTANT	125.30	699	145.35	1409	74.37	1356
TOTAL LAP LOAD (LB)	265.84	699	304.86	1408	163.62	1356
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	-2.23	466	9.96	1317	-46.11	1371
X AXIS (RIGHT)	0.11	520	-2.23	1259	-43.75	1361
X AXIS (SUM)	-3.32	535	2.46	1317	-85.77	1371
Y AXIS (CENTER)	1.71	472	1.71	1700	-32.57	1356
SEAT LOADS (LB)						
Z AXIS (LEFT)	82.20	457	446.62	1384	17.33	1191
Z AXIS (RIGHT)	68.57	457	425.25	1379	9.18	1317
Z AXIS (CENTER)	144.56	1301	1308.63	1372	81.21	1196
Z AXIS (SUM)	219.62	457	2102.87	1377	122.81	1191
SEAT Z SUM / WT	1.31	457	12.52	1377	0.73	1191
RESULTANT SEAT LOAD (LB)	219.77	457	2104.48	1377	123.85	1191

VERTICAL TEST PHASE      TEST: 677      SUBJ: H-6      WT: 189.0      CELL: G

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1192		
TIME OF IMPACT START				1315		
CARRIAGE ACCELERATION (G)						
X AXIS			1.73	1354	-1.74	1362
Y AXIS			0.21	1310	-0.65	1374
Z AXIS			10.62	1352	-0.13	1242
Z AXIS (SMOOTHED)			9.94	1358	-0.05	1232
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.02	1307	-26.14	1656
TACHOMETER (MEASURED)			-1.18	1706	-26.29	1315
SEAT ACCELERATION (G)						
X AXIS			1.44	1354	-1.80	1358
Y AXIS			1.18	1360	-0.56	1366
Z AXIS			11.54	1354	-0.10	1294
Z AXIS (SMOOTHED)			10.79	1354	-0.08	1233
CHEST ACCELERATION (G)						
X AXIS			3.24	1370	-1.55	1418
Y AXIS			0.63	1462	-3.74	1382
Z AXIS			17.85	1378	-0.88	1302
RESULTANT			18.26	1375	0.25	1320
CHEST SEVERITY INDEX			33.09			
HEAD ACCELERATION (G)						
X AXIS			5.14	1376	-0.39	1492
Y AXIS			0.78	1424	-1.92	1396
Z AXIS			11.93	1378	-0.40	1226
RESULTANT			13.03	1376	0.14	1476
HEAD SEVERITY INDEX			25.03			
SHOULDER STRAP LOADS (LB)						
X AXIS	97.36	1288	194.31	1407	77.38	1339
Y AXIS	0.08	479	22.19	1405		
Z AXIS	6.86	813	55.16	1397		
RESULTANT	97.43	1297	201.98	1407	78.48	1339
LEFT LAP LOADS (LB)						
X AXIS	83.74	1293	104.92	1396	37.65	1353
Y AXIS	35.43	1298	32.49	1406	11.86	1358
Z AXIS	97.90	1292	85.75	1406	19.95	1352
RESULTANT	132.42	1293	138.27	1404	44.73	1353
RIGHT LAP LOADS (LB)						
X AXIS	66.84	1295	93.64	1407	24.71	1355
Y AXIS	29.68	1280	33.57	1409	10.24	1354
Z AXIS	83.90	1294	88.07	1408	5.67	1354
RESULTANT	110.17	1295	131.85	1407	28.16	1355
TOTAL LAP LOAD (LB)	241.99	1293	268.56	1407	73.18	1355
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	9.18	792	21.98	1442	-17.03	1385
X AXIS (RIGHT)	-5.19	633	11.77	1467	-44.37	1368
X AXIS (SUM)	-0.11	792	27.16	1454	-57.75	1369
Y AXIS (CENTER)	5.23	839	2.69	1190	-66.52	1365
SEAT LOADS (LB)						
Z AXIS (LEFT)	88.54	456	444.51	1382	20.27	1666
Z AXIS (RIGHT)	56.02	456	423.81	1386	25.23	1310
Z AXIS (CENTER)	145.85	1301	1367.89	1370	75.64	1194
Z AXIS (SUM)	222.70	456	2172.74	1371	171.29	1194
SEAT Z SUM / WT	1.18	456	11.50	1371	0.91	1194
RESULTANT SEAT LOAD (LB)	222.82	456	2174.33	1371	171.77	1194

## VERTICAL TEST PHASE

TEST: 658

SUBJ: J-4

WT: 185.0

CELL: G

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1180		
TIME OF IMPACT START				1307		
CARRIAGE ACCELERATION (G)						
X AXIS			2.93	1306	-2.10	1311
Y AXIS			0.22	1481	-0.85	1308
Z AXIS			10.51	1340	-0.12	1273
Z AXIS (SMOOTHED)			9.95	1353	-0.02	1191
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1298	-26.20	1624
TACHOMETER (MEASURED)			-1.18	1723	-26.27	1307
SEAT ACCELERATION (G)						
X AXIS			2.53	1305	-1.79	1311
Y AXIS			1.77	1353	-0.73	1302
Z AXIS			11.73	1344	-0.15	1193
Z AXIS (SMOOTHED)			10.77	1342	-0.09	1190
CHEST ACCELERATION (G)						
X AXIS			1.32	1348	-0.86	1400
Y AXIS			0.83	1442	-1.04	1367
Z AXIS			16.44	1371	-0.80	1272
RESULTANT			16.49	1368	0.30	1310
CHEST SEVERITY INDEX			27.67			
HEAD ACCELERATION (G)						
X AXIS			3.65	1357	-1.21	1405
Y AXIS			2.87	1462	-0.68	1491
Z AXIS			12.40	1358	-1.77	1458
RESULTANT			12.92	1355	0.42	1211
HEAD SEVERITY INDEX			24.06			
SHOULDER STRAP LOADS (LB)						
X AXIS	126.19	639	156.17	1387	85.21	1342
Y AXIS	1.59	1276	14.39	1388		
Z AXIS	-2.06	445	16.52	1375		
RESULTANT	126.67	639	157.03	1387	86.02	1342
LEFT LAP LOADS (LB)						
X AXIS	114.49	1267	68.39	1394	28.53	1342
Y AXIS	54.01	1257	31.61	1382	12.16	1350
Z AXIS	144.19	1262	69.27	1445	14.60	1344
RESULTANT	190.95	1267	98.27	1394	35.18	1344
RIGHT LAP LOADS (LB)						
X AXIS	109.14	1289	78.50	1386	31.27	1343
Y AXIS	33.16	1283	20.19	1448	5.29	1342
Z AXIS	151.78	1275	82.94	1443	20.36	1343
RESULTANT	188.80	1278	110.06	1393	37.69	1343
TOTAL LAP LOAD (LB)	377.86	1267	208.03	1393	73.08	1344
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	4.51	1163	27.67	1303	-7.68	1374
X AXIS (RIGHT)	4.74	445	1.23	1419	-53.16	1347
X AXIS (SUM)	3.23	447	16.10	1421	-51.70	1347
Y AXIS (CENTER)	4.77	1266	5.41	1306	-16.61	1355
SEAT LOADS (LB)						
Z AXIS (LEFT)	77.83	1177	483.22	1373	44.17	1299
Z AXIS (RIGHT)	75.03	1280	555.00	1370	38.15	1733
Z AXIS (CENTER)	236.46	1289	1295.60	1357	157.36	1756
Z AXIS (SUM)	361.25	1289	2265.30	1362	254.70	1762
SEAT Z SUM / WT	1.95	1289	12.24	1362	1.38	1762
RESULTANT SEAT LOAD (LB)	361.53	1289	2265.82	1362	254.71	1762

VERTICAL TEST PHASE      TEST: 707      SUBJ: K-1      WT: 182.0      CELL: G

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1290		
TIME OF IMPACT START				1358		
CARRIAGE ACCELERATION (G)						
X AXIS			2.32	1356	-1.69	1402
Y AXIS			0.51	1358	-0.48	1426
Z AXIS			10.77	1392	-0.13	1314
Z AXIS (SMOOTHED)			9.95	1396	-0.04	1312
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1349	-26.26	1692
TACHOMETER (MEASURED)			-0.83	1714	-25.98	1358
SEAT ACCELERATION (G)						
X AXIS			2.08	1356	-1.43	1402
Y AXIS			1.35	1404	-0.89	1396
Z AXIS			12.28	1396	-0.18	1268
Z AXIS (SMOOTHED)			10.83	1393	-0.15	1266
CHEST ACCELERATION (G)						
X AXIS			3.52	1430	-0.20	1506
Y AXIS			1.44	1490	-3.08	1430
Z AXIS			14.64	1416	-0.65	1264
RESULTANT			15.03	1426	0.18	1353
CHEST SEVERITY INDEX			31.95			
HEAD ACCELERATION (G)						
X AXIS			1.30	1408	-3.03	1456
Y AXIS			0.93	1536	-0.57	1414
Z AXIS			13.23	1414	-0.43	1290
RESULTANT			13.28	1411	0.80	1353
HEAD SEVERITY INDEX			23.69			
SHOULDER STRAP LOADS (LB)						
X AXIS	101.24	1323	150.21	1444	96.24	1372
Y AXIS	2.94	510	3.53	1508		
Z AXIS	4.68	991	31.92	1422		
RESULTANT	101.32	1323	153.47	1435	96.31	1373
LEFT LAP LOADS (LB)						
X AXIS	136.85	1322	143.84	1419	81.55	1394
Y AXIS	46.90	1338	39.83	1419	23.92	1400
Z AXIS	149.03	1337	113.60	1419	60.95	1393
RESULTANT	208.30	1338	187.56	1419	105.73	1394
RIGHT LAP LOADS (LB)						
X AXIS	124.53	1315	107.94	1424	65.81	1394
Y AXIS	46.44	1314	36.07	1425	20.52	1394
Z AXIS	136.49	1328	87.47	1421	41.57	1395
RESULTANT	189.52	1328	142.74	1422	81.89	1395
TOTAL LAP LOAD (LB)	397.89	1328	329.18	1419	188.47	1394
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	4.61	852	15.58	1352	-30.13	1424
X AXIS (RIGHT)	-2.16	810	8.95	1489	-41.35	1407
X AXIS (SUM)	0.66	974	16.70	1514	-53.56	1417
Y AXIS (CENTER)	1.96	570	-1.85	1681	-66.62	1413
SEAT LOADS (LB)						
Z AXIS (LEFT)	81.08	1263	490.51	1413	23.43	1702
Z AXIS (RIGHT)	72.92	494	433.00	1410	31.69	1710
Z AXIS (CENTER)	221.12	1340	1446.44	1411	123.90	1820
Z AXIS (SUM)	346.63	1317	2359.21	1412	209.30	1702
SEAT Z SUM / WT	1.90	1317	12.96	1412	1.15	1702
RESULTANT SEAT LOAD (LB)	346.94	1317	2360.59	1412	209.34	1702

VERTICAL TEST PHASE

TEST: 657

SUBJ: M13

WT: 175.0

CELL: G

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1254		
TIME OF IMPACT START				1380		
CARRIAGE ACCELERATION (G)						
X AXIS			2.40	1378	-1.92	1383
Y AXIS			1.42	1429	-1.03	1434
Z AXIS			10.52	1414	-0.13	1271
Z AXIS (SMOOTHED)			10.01	1425	-0.03	1284
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1371	-26.11	1697
TACHOMETER (MEASURED)			-1.18	1838	-26.24	1380
SEAT ACCELERATION (G)						
X AXIS			2.00	1377	-1.58	1423
Y AXIS			1.68	1436	-0.86	1470
Z AXIS			11.49	1418	-0.10	1346
Z AXIS (SMOOTHED)			10.74	1416	-0.08	1336
CHEST ACCELERATION (G)						
X AXIS			2.23	1430	-0.63	1494
Y AXIS			0.83	1381	-0.56	1684
Z AXIS			14.88	1440	-0.75	1335
RESULTANT			15.03	1437	0.32	1382
CHEST SEVERITY INDEX			28.65			
HEAD ACCELERATION (G)						
X AXIS			2.48	1428	-0.50	1380
Y AXIS			1.18	1413	-0.25	1452
Z AXIS			12.04	1438	-0.88	1264
RESULTANT			12.22	1427	0.73	1504
HEAD SEVERITY INDEX			21.12			
SHOULDER STRAP LOADS (LB)						
X AXIS	74.78	1356	122.75	1456	64.78	1395
Y AXIS	7.85	884	10.18	1455		
Z AXIS	1.02	520	27.02	1435		
RESULTANT	75.23	1361	125.59	1455	65.47	1395
LEFT LAP LOADS (LB)						
X AXIS	99.68	1361	98.42	1446	82.29	1416
Y AXIS	34.68	1362	34.09	1449	21.71	1410
Z AXIS	83.65	1360	63.28	1449	33.92	1417
RESULTANT	139.99	1361	120.86	1447	74.71	1417
RIGHT LAP LOADS (LB)						
X AXIS	88.92	1336	87.64	1448	55.73	1416
Y AXIS	28.46	1319	24.58	1449	14.21	1412
Z AXIS	89.76	1333	59.51	1447	29.27	1415
RESULTANT	128.65	1355	108.19	1446	65.01	1416
TOTAL LAP LOAD (LB)	268.13	1363	229.01	1446	140.37	1416
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	12.38	869	14.82	1473	-21.14	1412
X AXIS (RIGHT)	13.33	519	8.07	1260	-15.91	1440
X AXIS (SUM)	23.30	694	19.94	1374	-33.46	1420
Y AXIS (CENTER)	5.35	519	-6.72	1266	-28.94	1414
SEAT LOADS (LB)						
Z AXIS (LEFT)	83.25	518	488.24	1440	35.79	1366
Z AXIS (RIGHT)	104.19	519	524.54	1441	42.94	1701
Z AXIS (CENTER)	102.38	1363	1225.05	1430	26.37	1256
Z AXIS (SUM)	252.54	518	2151.35	1439	154.70	1251
SEAT Z SUM / WT	1.44	518	12.29	1439	0.88	1251
RESULTANT SEAT LOAD (LB)	253.43	518	2151.50	1439	155.29	1251

VERTICAL TEST PHASE      TEST: 669      SUBJ: P-3      WT: 206.0      CELL: G

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1244		
TIME OF IMPACT START				1373		
CARRIAGE ACCELERATION (G)						
X AXIS			3.07	1370	-2.58	1376
Y AXIS			0.73	1368	-0.95	1444
Z AXIS			10.52	1406	-0.11	1296
Z AXIS (SMOOTHED)			9.90	1418	-0.02	1295
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.02	1361	-26.12	1692
TACHOMETER (MEASURED)			-1.18	1752	-26.27	1373
SEAT ACCELERATION (G)						
X AXIS			2.65	1370	-2.13	1412
Y AXIS			2.28	1376	-1.67	1384
Z AXIS			11.99	1412	-0.29	1332
Z AXIS (SMOOTHED)			11.06	1409	-0.11	1329
CHEST ACCELERATION (G)						
X AXIS			3.82	1424	-1.67	1474
Y AXIS			1.22	1458	-1.49	1444
Z AXIS			16.16	1430	-1.05	1330
RESULTANT			16.51	1427	0.50	1367
CHEST SEVERITY INDEX			30.63			
HEAD ACCELERATION (G)						
X AXIS			2.67	1418	-1.59	1470
Y AXIS			1.26	1626	-1.07	1444
Z AXIS			12.25	1418	-0.82	1352
RESULTANT			12.58	1418	0.10	1505
HEAD SEVERITY INDEX			22.26			
SHOULDER STRAP LOADS (LB)						
X AXIS	145.26	1351	263.19	1462	99.28	1406
Y AXIS	1.02	830	-0.14	1778		
Z AXIS	-3.39	514	4.04	1420		
RESULTANT	151.60	1354	264.03	1462	100.23	1406
LEFT LAP LOADS (LB)						
X AXIS	175.08	1348	148.89	1432	105.29	1407
Y AXIS	54.05	1344	38.72	1463	25.17	1414
Z AXIS	188.62	1355	123.82	1431	81.30	1409
RESULTANT	262.95	1355	197.26	1431	135.97	1409
RIGHT LAP LOADS (LB)						
X AXIS	150.09	1352	128.39	1430	81.16	1409
Y AXIS	58.30	1350	45.99	1432	24.60	1410
Z AXIS	178.90	1355	116.32	1436	68.34	1408
RESULTANT	238.91	1352	177.84	1436	109.21	1409
TOTAL LAP LOAD (LB)	501.90	1355	374.74	1431	245.18	1409
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	1.15	922	13.33	1496	-52.49	1423
X AXIS (RIGHT)	1.04	955	5.13	1371	-28.20	1412
X AXIS (SUM)	0.99	933	5.77	1370	-75.42	1423
Y AXIS (CENTER)	-0.22	549	-2.76	1710	-103.08	1410
SEAT LOADS (LB)						
Z AXIS (LEFT)	101.25	1327	587.05	1433	80.90	1247
Z AXIS (RIGHT)	61.18	509	511.20	1434	29.86	1645
Z AXIS (CENTER)	266.77	1354	1565.47	1423	130.94	1241
Z AXIS (SUM)	403.40	1355	2557.40	1424	237.12	1240
SEAT Z SUM / WT	1.96	1355	12.41	1424	1.15	1240
RESULTANT SEAT LOAD (LB)	404.25	1355	2559.97	1424	237.27	1240



VERTICAL TEST PHASE      TEST: 667      SUBJ: R-2      WT: 146.0      CELL: G

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1226		
TIME OF IMPACT START				1353		
CARRIAGE ACCELERATION (G)						
X AXIS			1.52	1392	-1.48	1396
Y AXIS			0.44	1344	-0.59	1374
Z AXIS			10.59	1387	-0.11	1308
Z AXIS (SMOOTHED)			9.94	1399	-0.03	1310
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.02	1341	-26.05	1652
TACHOMETER (MEASURED)			-1.17	1738	-26.19	1353
SEAT ACCELERATION (G)						
X AXIS			1.26	1350	-1.51	1396
Y AXIS			1.45	1396	-0.80	1346
Z AXIS			11.63	1388	-0.12	1316
Z AXIS (SMOOTHED)			10.78	1389	-0.09	1220
CHEST ACCELERATION (G)						
X AXIS			3.27	1412	-0.41	1492
Y AXIS			0.92	1456	-2.19	1414
Z AXIS			15.90	1404	-0.69	1302
RESULTANT			16.11	1401	0.43	1340
CHEST SEVERITY INDEX			31.80			
HEAD ACCELERATION (G)						
X AXIS			0.99	1466	-3.02	1422
Y AXIS			1.25	1406	-0.01	1446
Z AXIS			12.94	1406	-0.64	1314
RESULTANT			13.02	1403	0.71	1347
HEAD SEVERITY INDEX			22.39			
SHOULDER STRAP LOADS (LB)						
X AXIS	68.42	1330	125.39	1417	69.42	1388
Y AXIS	4.82	1244	18.20	1418		
Z AXIS	8.30	1327	44.21	1416		
RESULTANT	68.85	1330	134.04	1416	73.29	1369
LEFT LAP LOADS (LB)						
X AXIS	87.58	1330	77.61	1415	35.26	1389
Y AXIS	41.41	1329	31.98	1418	16.66	1392
Z AXIS	95.78	1330	55.28	1414	17.82	1390
RESULTANT	136.23	1336	100.51	1415	44.96	1389
RIGHT LAP LOADS (LB)						
X AXIS	83.63	1333	75.98	1421	31.30	1389
Y AXIS	36.67	1333	28.89	1421	12.69	1389
Z AXIS	102.07	1336	59.31	1414	17.59	1388
RESULTANT	136.79	1336	100.44	1415	38.08	1389
TOTAL LAP LOAD (LB)	273.01	1336	200.94	1415	83.03	1389
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	8.13	1336	39.21	1398	2.04	1293
X AXIS (RIGHT)	-0.87	491	-0.28	1465	-30.69	1414
X AXIS (SUM)	2.41	493	16.12	1398	-11.10	1420
Y AXIS (CENTER)	3.54	547	1.64	1220	-37.73	1388
SEAT LOADS (LB)						
Z AXIS (LEFT)	30.54	490	325.43	1405	11.06	1232
Z AXIS (RIGHT)	40.85	1335	491.60	1404	17.14	1239
Z AXIS (CENTER)	172.91	1335	1237.65	1406	104.07	1229
Z AXIS (SUM)	241.59	1335	2049.51	1405	138.94	1220
SEAT Z SUM / WT	1.65	1335	14.04	1405	0.95	1220
RESULTANT SEAT LOAD (LB)	241.62	1335	2049.77	1405	138.97	1220

VERTICAL TEST PHASE

TEST: 724

SUBJ: S-6

WT: 115.0

CELL: G

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1182		
TIME OF IMPACT START				1304		
CARRIAGE ACCELERATION (G)						
X AXIS			3.46	1310	-2.46	1312
Y AXIS			0.78	1364	-0.61	1310
Z AXIS			10.75	1345	-0.12	1202
Z AXIS (SMOOTHED)			10.06	1356	-0.02	1250
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1302	-26.09	1636
TACHOMETER (MEASURED)			-1.17	1706	-26.25	1304
SEAT ACCELERATION (G)						
X AXIS			2.66	1310	-1.91	1312
Y AXIS			1.04	1354	-0.69	1324
Z AXIS			12.55	1348	-0.09	1312
Z AXIS (SMOOTHED)			11.19	1346	-0.03	1231
CHEST ACCELERATION (G)						
X AXIS			1.47	1350	-0.33	1318
Y AXIS			0.25	1374	-2.48	1362
Z AXIS			21.82	1364	-0.77	1250
RESULTANT			21.88	1361	0.67	1315
CHEST SEVERITY INDEX			29.55			
HEAD ACCELERATION (G)						
X AXIS			4.85	1366	-0.42	1558
Y AXIS			1.26	1696	-0.53	1366
Z AXIS			11.63	1370	-0.59	1277
RESULTANT			12.55	1364	0.46	1710
HEAD SEVERITY INDEX			20.79			
SHOULDER STRAP LOADS (LB)						
X AXIS	43.67	1209	130.62	1394	48.67	1325
Y AXIS	5.28	1216	9.35	1459		
Z AXIS	14.54	1115	73.98	1376		
RESULTANT	45.84	1222	148.70	1385	54.62	1325
LEFT LAP LOADS (LB)						
X AXIS	75.94	1280	102.10	1371	58.50	1326
Y AXIS	36.16	1283	43.83	1374	25.56	1326
Z AXIS	83.30	1266	81.28	1372	46.86	1345
RESULTANT	118.21	1285	137.30	1371	84.24	1326
RIGHT LAP LOADS (LB)						
X AXIS	69.49	1293	93.74	1370	50.34	1325
Y AXIS	31.61	1250	38.09	1369	20.60	1335
Z AXIS	76.56	1281	71.34	1369	36.92	1345
RESULTANT	107.38	1293	123.01	1370	72.50	1325
TOTAL LAP LOAD (LB)	224.88	1293	259.34	1371	157.97	1325
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	2.17	526	43.00	1440	-7.58	1254
X AXIS (RIGHT)	4.78	448	9.44	1308	-44.95	1316
X AXIS (SUM)	2.84	526	25.14	1307	-32.45	1373
Y AXIS (CENTER)	5.50	526	9.31	1312	-40.22	1360
SEAT LOADS (LB)						
Z AXIS (LEFT)	25.93	447	258.72	1363	6.57	1603
Z AXIS (RIGHT)	21.89	448	216.27	1363	5.07	1661
Z AXIS (CENTER)	102.37	1289	855.03	1362	70.21	1180
Z AXIS (SUM)	131.29	447	1429.27	1363	103.84	1182
SEAT Z SUM / WT	1.14	447	12.43	1363	0.90	1182
RESULTANT SEAT LOAD (LB)	131.43	1290	1429.98	1363	103.88	1182

VERTICAL TEST PHASE      TEST: 684      SUBJ: W-3      WT: 176.0      CELL: G

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1298		
TIME OF IMPACT START				1357		
CARRIAGE ACCELERATION (G)						
X AXIS			1.31	1402	-1.60	1404
Y AXIS			0.42	1354	-0.86	1362
Z AXIS			10.64	1397	-0.09	1248
Z AXIS (SMOOTHED)			9.95	1408	-0.03	1293
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1353	-26.05	1700
TACHOMETER (MEASURED)			-1.20	1719	-26.25	1357
SEAT ACCELERATION (G)						
X AXIS			1.00	1402	-1.46	1406
Y AXIS			1.30	1404	-0.83	1370
Z AXIS			12.08	1398	-0.17	1328
Z AXIS (SMOOTHED)			10.87	1398	-0.10	1281
CHEST ACCELERATION (G)						
X AXIS			0.50	1528	-1.35	1448
Y AXIS			0.02	1400	-1.72	1828
Z AXIS			14.16	1432	-1.09	1336
RESULTANT			14.21	1432	0.72	1356
CHEST SEVERITY INDEX			28.29			
HEAD ACCELERATION (G)						
X AXIS			2.32	1408	-1.25	1464
Y AXIS			1.57	1540	0.13	1450
Z AXIS			11.02	1424	-0.53	1280
RESULTANT			11.20	1424	0.61	1830
HEAD SEVERITY INDEX			22.32			
SHOULDER STRAP LOADS (LB)						
X AXIS	93.49	1342	162.45	1452	78.49	1380
Y AXIS	3.77	509	6.10	1563		
Z AXIS	5.92	508	28.21	1420		
RESULTANT	93.58	1342	164.30	1452	78.82	1380
LEFT LAP LOADS (LB)						
X AXIS	70.69	1323	68.19	1453	33.31	1391
Y AXIS	30.28	1336	25.57	1502	11.42	1403
Z AXIS	82.23	1327	59.96	1498	14.40	1397
RESULTANT	111.69	1331	90.53	1463	38.42	1399
RIGHT LAP LOADS (LB)						
X AXIS	63.87	1330	60.05	1430	25.58	1398
Y AXIS	28.89	1329	24.70	1432	10.45	1389
Z AXIS	79.60	1334	52.48	1505	6.59	1397
RESULTANT	105.57	1330	76.39	1430	28.96	1398
TOTAL LAP LOAD (LB)	216.32	1330	161.28	1453	68.58	1398
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	10.10	974	22.90	1484	-40.48	1404
X AXIS (RIGHT)	12.68	501	9.17	1408	-7.79	1429
X AXIS (SUM)	20.95	501	23.79	1498	-39.50	1404
Y AXIS (CENTER)	63.46	503	41.24	1830	-7.66	1414
SEAT LOADS (LB)						
Z AXIS (LEFT)	38.35	501	485.06	1425	15.01	1231
Z AXIS (RIGHT)	61.00	500	398.67	1416	21.87	1239
Z AXIS (CENTER)	141.64	1345	1306.52	1415	100.05	1230
Z AXIS (SUM)	217.36	500	2142.00	1417	148.83	1230
SEAT Z SUM / WT	1.24	500	12.17	1417	0.85	1230
RESULTANT SEAT LOAD (LB)	226.72	500	2142.18	1417	151.73	1230

## VERTICAL TEST PHASE

TEST: 674

SUBJ: W-4

WT: 193.0

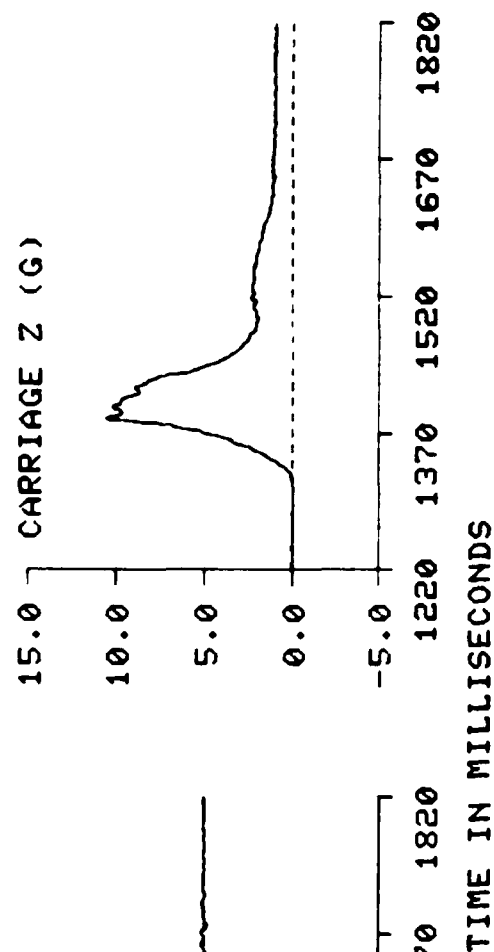
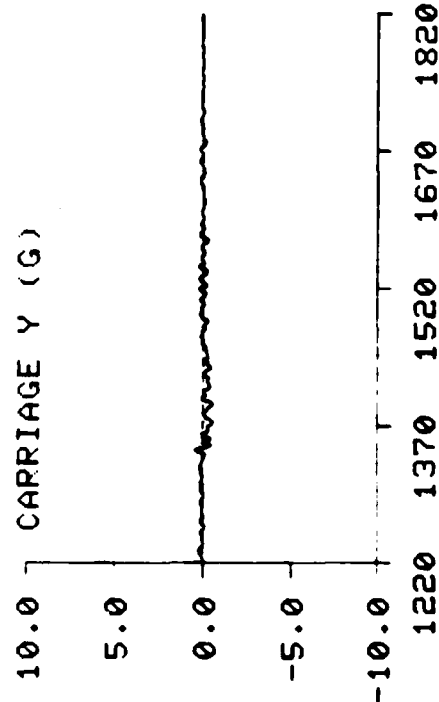
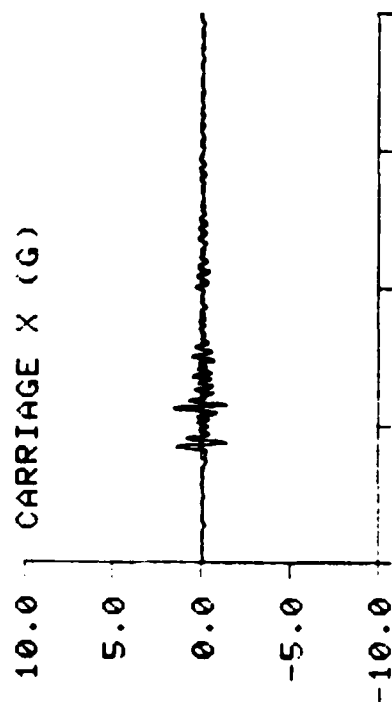
CELL: G

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1184		
TIME OF IMPACT START				1306		
CARRIAGE ACCELERATION (G)						
X AXIS			2.99	1308	-1.74	1314
Y AXIS			0.67	1308	-0.70	1338
Z AXIS			10.56	1344	-0.12	1220
Z AXIS (SMOOTHED)			9.92	1353	-0.03	1217
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1300	-26.15	1644
TACHOMETER (MEASURED)			-1.18	1707	-26.20	1306
SEAT ACCELERATION (G)						
X AXIS			2.76	1308	-1.69	1350
Y AXIS			1.38	1354	-1.26	1324
Z AXIS			11.38	1346	-0.31	1198
Z AXIS (SMOOTHED)			10.71	1347	-0.21	1196
CHEST ACCELERATION (G)						
X AXIS			2.92	1368	-0.87	1412
Y AXIS			1.34	1442	-1.99	1376
Z AXIS			16.29	1374	-0.79	1282
RESULTANT			16.46	1371	0.27	1475
CHEST SEVERITY INDEX			30.09			
HEAD ACCELERATION (G)						
X AXIS			4.43	1362	-0.95	1770
Y AXIS			1.06	1428	-0.51	1390
Z AXIS			12.24	1364	-0.88	1280
RESULTANT			13.01	1364	0.55	1571
HEAD SEVERITY INDEX			20.56			
SHOULDER STRAP LOADS (LB)						
X AXIS	89.75	1288	158.71	1397	81.75	1345
Y AXIS	5.11	699	3.36	1760		
Z AXIS	5.10	449	31.11	1389		
RESULTANT	90.16	1291	161.31	1397	83.61	1345
LEFT LAP LOADS (LB)						
X AXIS	121.46	1289	127.89	1384	49.21	1347
Y AXIS	49.85	1283	38.06	1387	16.84	1354
Z AXIS	147.31	1290	107.83	1383	36.95	1346
RESULTANT	196.43	1292	170.64	1384	66.08	1347
RIGHT LAP LOADS (LB)						
X AXIS	100.18	1291	106.56	1388	41.46	1346
Y AXIS	46.22	1289	42.98	1382	15.76	1347
Z AXIS	133.09	1292	99.71	1392	26.70	1348
RESULTANT	172.14	1292	150.88	1389	52.80	1348
TOTAL LAP LOAD (LB)	368.56	1292	321.02	1384	119.97	1347
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	0.48	450	35.82	1435	-8.06	1300
X AXIS (RIGHT)	1.18	448	8.78	1463	-29.23	1378
X AXIS (SUM)	0.49	450	39.76	1462	-22.66	1378
Y AXIS (CENTER)	4.67	524	5.94	1469	-28.35	1357
SEAT LOADS (LB)						
Z AXIS (LEFT)	80.76	1272	557.79	1387	24.69	1676
Z AXIS (RIGHT)	43.10	447	549.31	1397	21.33	1220
Z AXIS (CENTER)	228.49	1292	1298.25	1360	130.11	1666
Z AXIS (SUM)	317.75	1292	2219.53	1361	202.63	1676
SEAT Z SUM / WT	1.65	1292	11.50	1361	1.05	1676
RESULTANT SEAT LOAD (LB)	318.04	1292	2219.70	1361	202.72	1676

RESTRAINT CONFIGURATION STUDY

TEST NO: 667

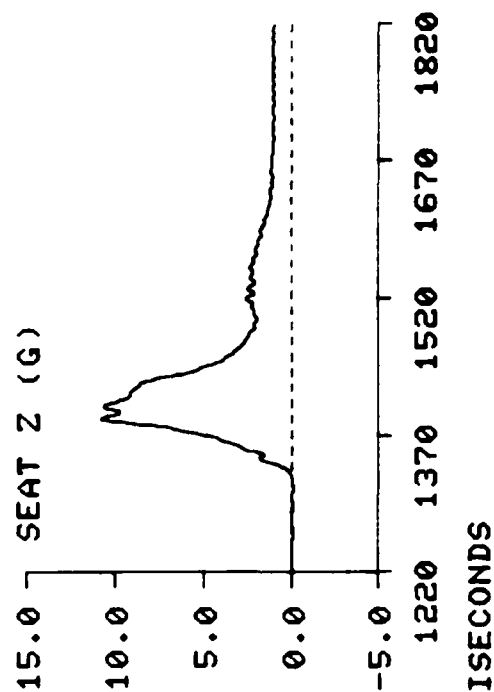
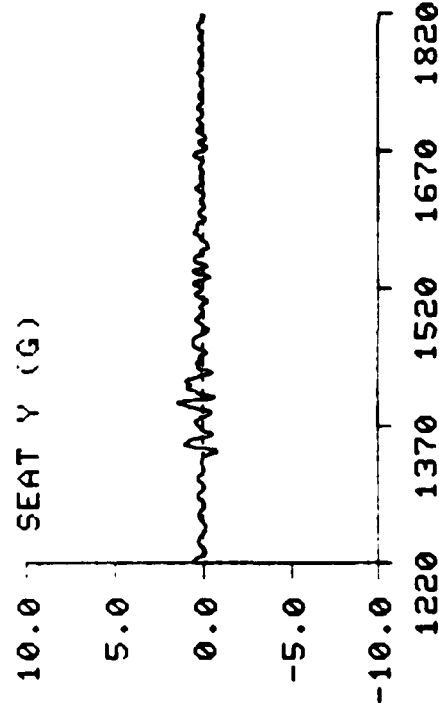
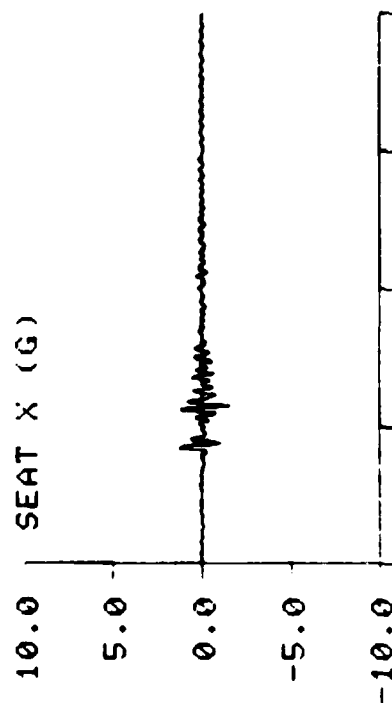
SUBJ ID: R-2



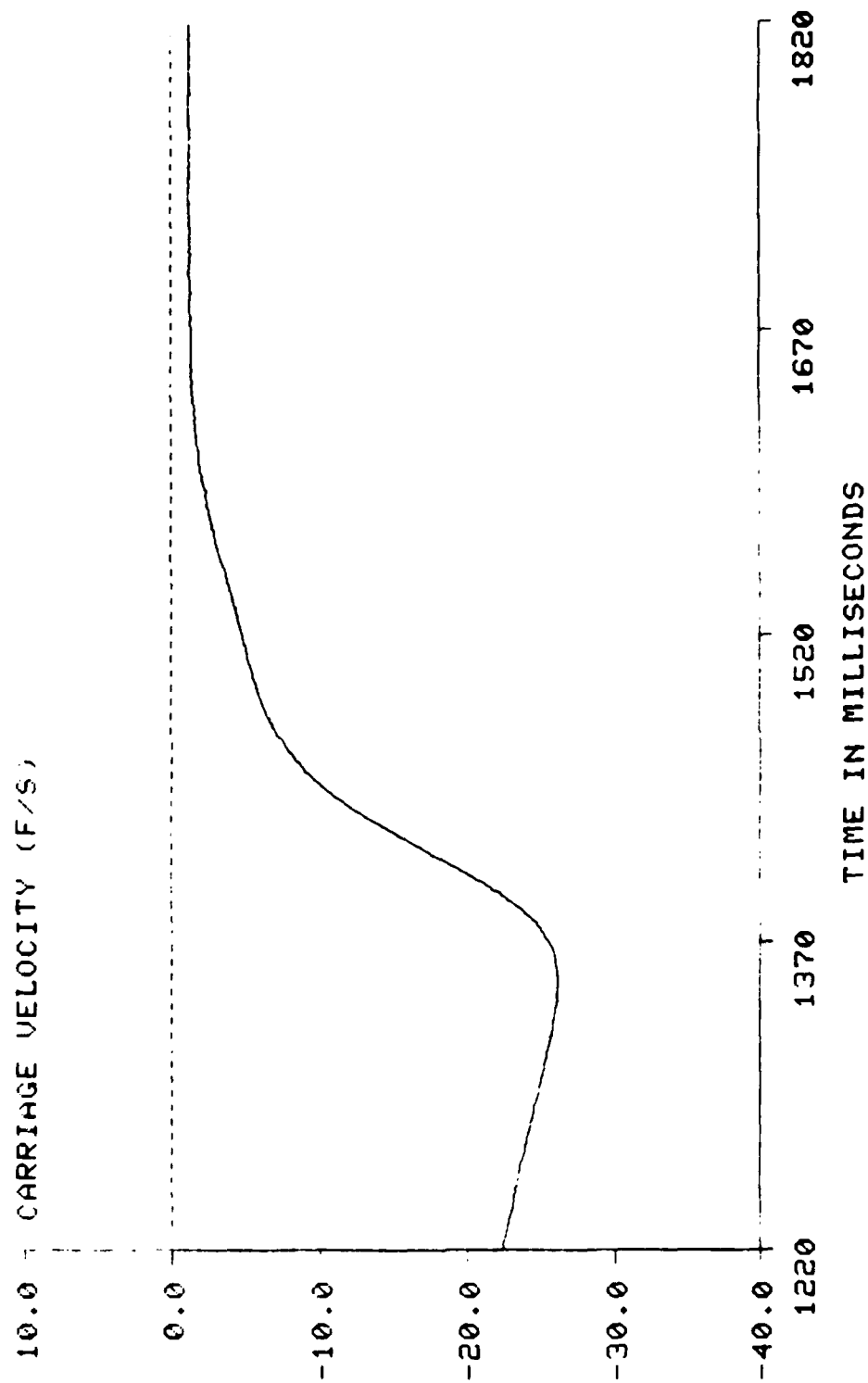
# RESTRAINT CONFIGURATION STUDY

TEST NO: 667

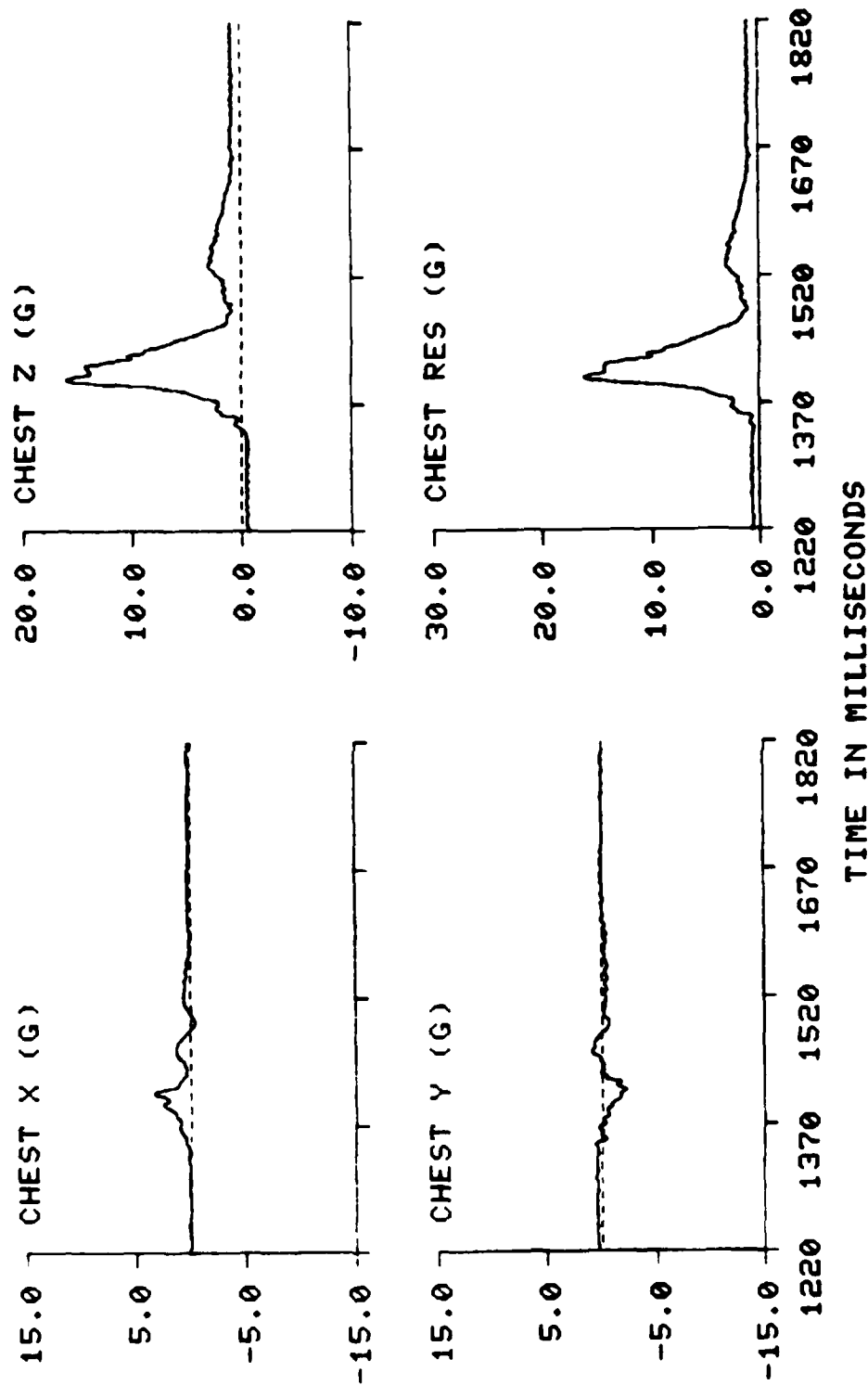
SUBJ ID: R-2



RESTRAINT CONFIGURATION STUDY      TEST NO: 667      SUBJ ID: R-2

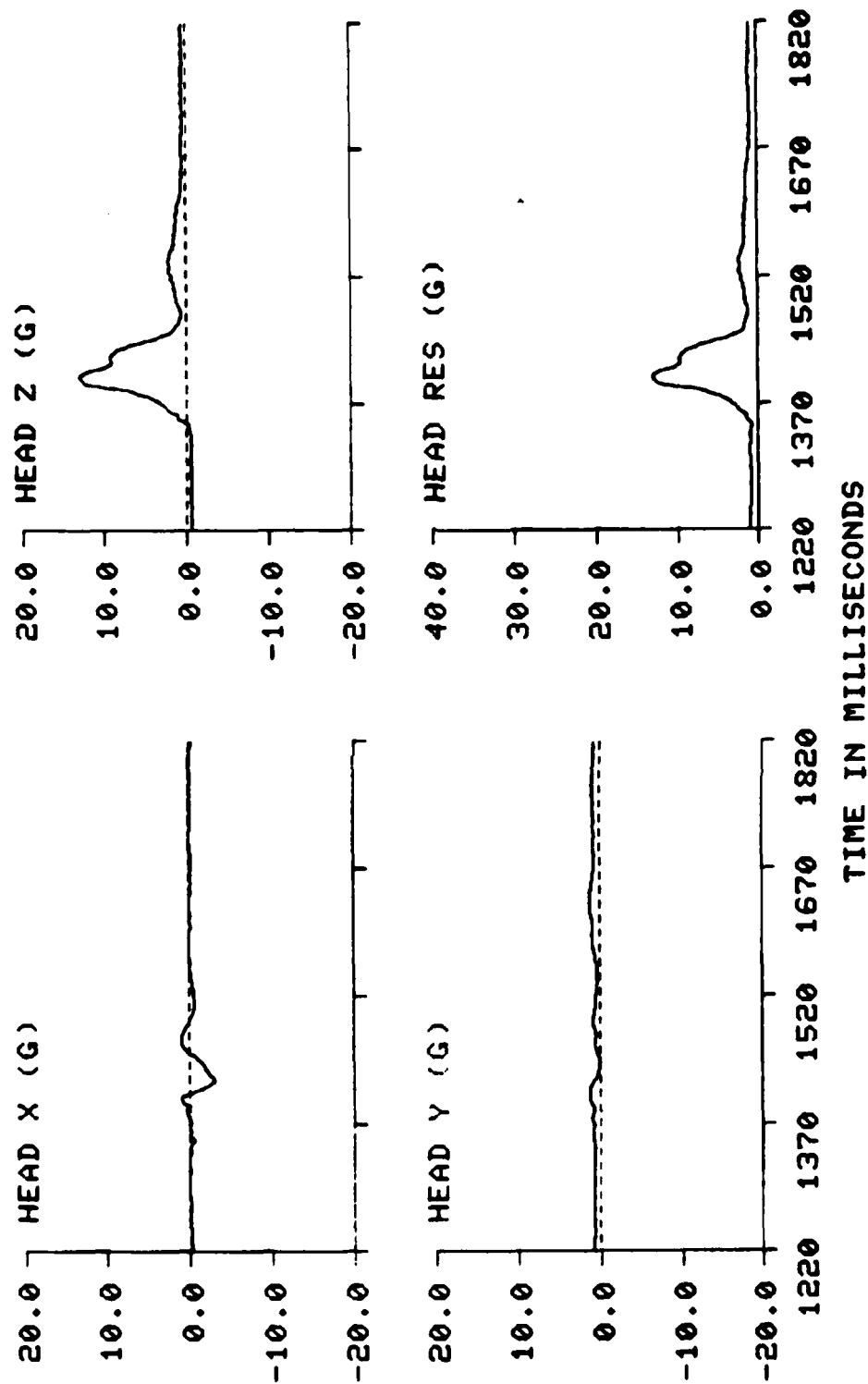


RESTRAINT CONFIGURATION STUDY      TEST NO: 667      SUBJ ID: R-2

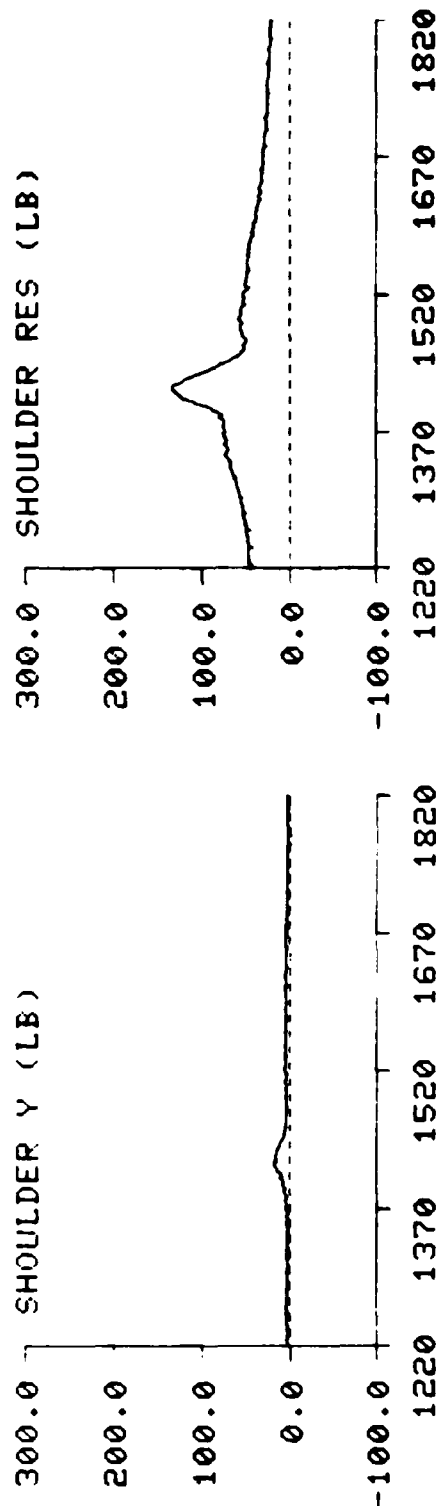
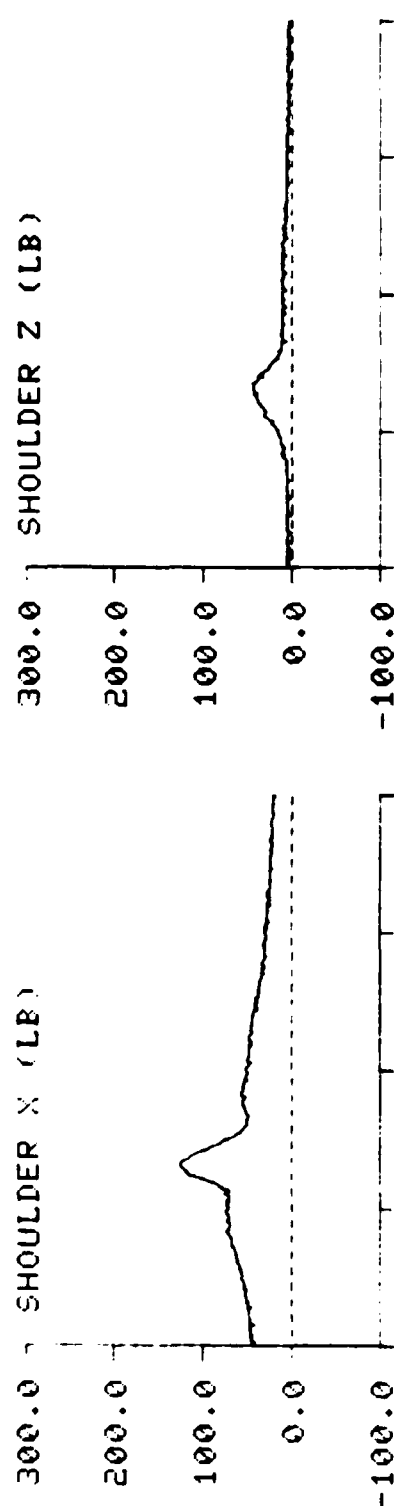




RESTRAINT CONFIGURATION STUDY      TEST NO: 667      SUBJ ID: R-2



RESTRAINT CONFIGURATION STUDY      TEST NO: 667      SUBJ ID: R-2

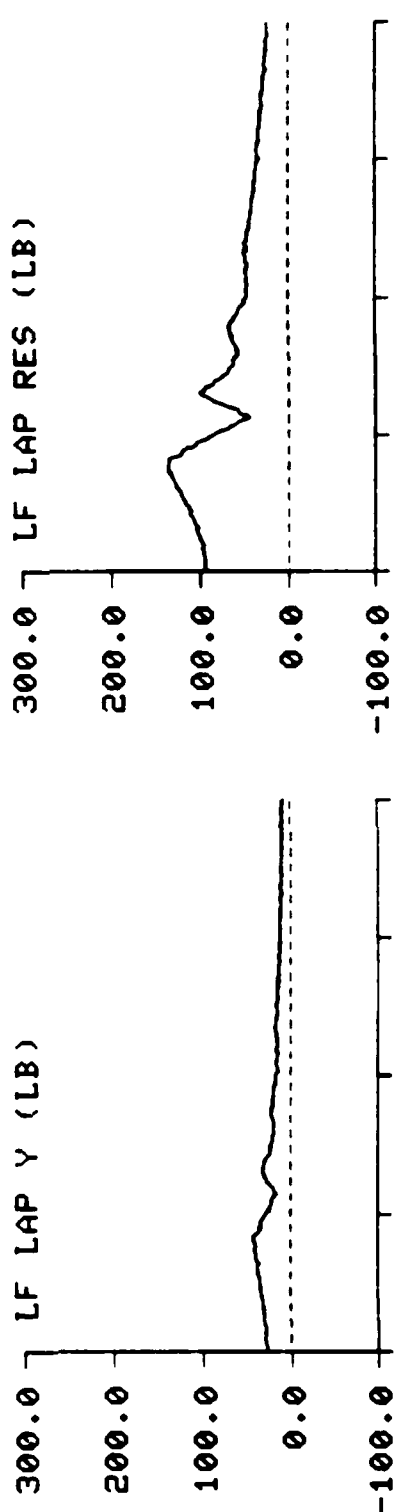
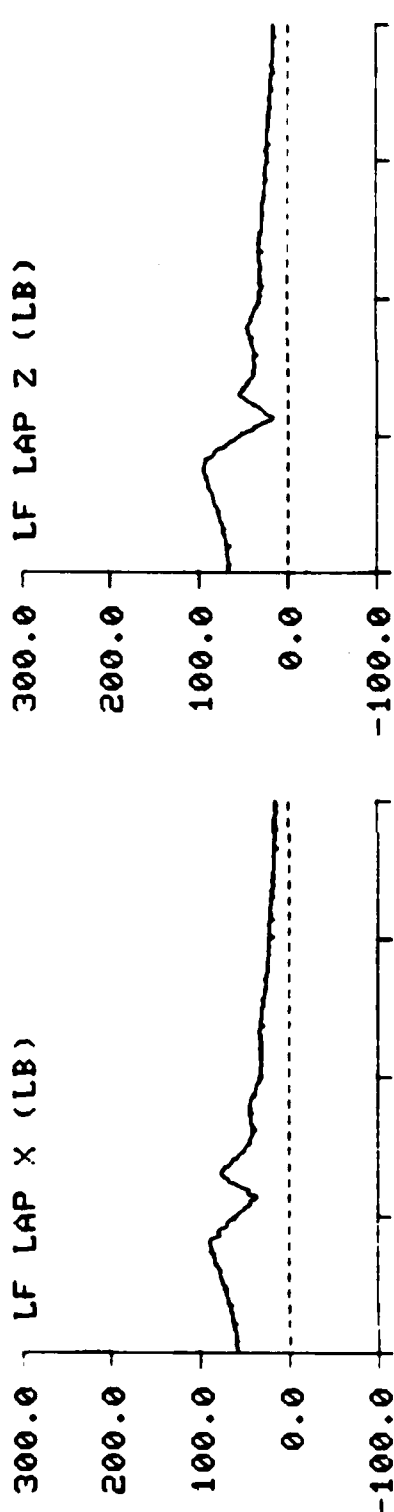


TIME IN MILLISECONDS

RESTRAINT CONFIGURATION STUDY

TEST NO: 667

SUBJ ID: R-2

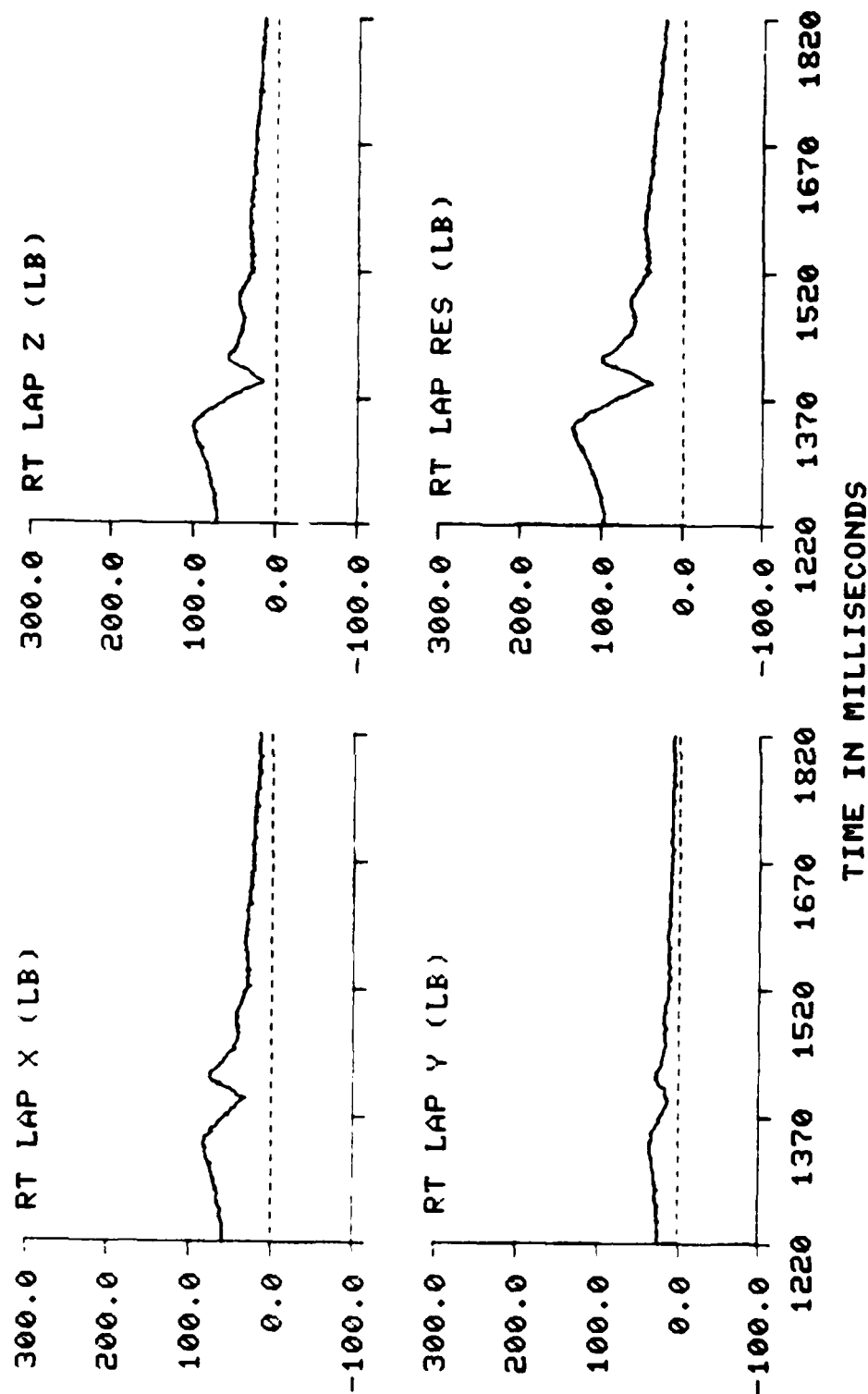


TIME IN MILLISECONDS

# RESTRAINT CONFIGURATION STUDY

TEST NO: 667

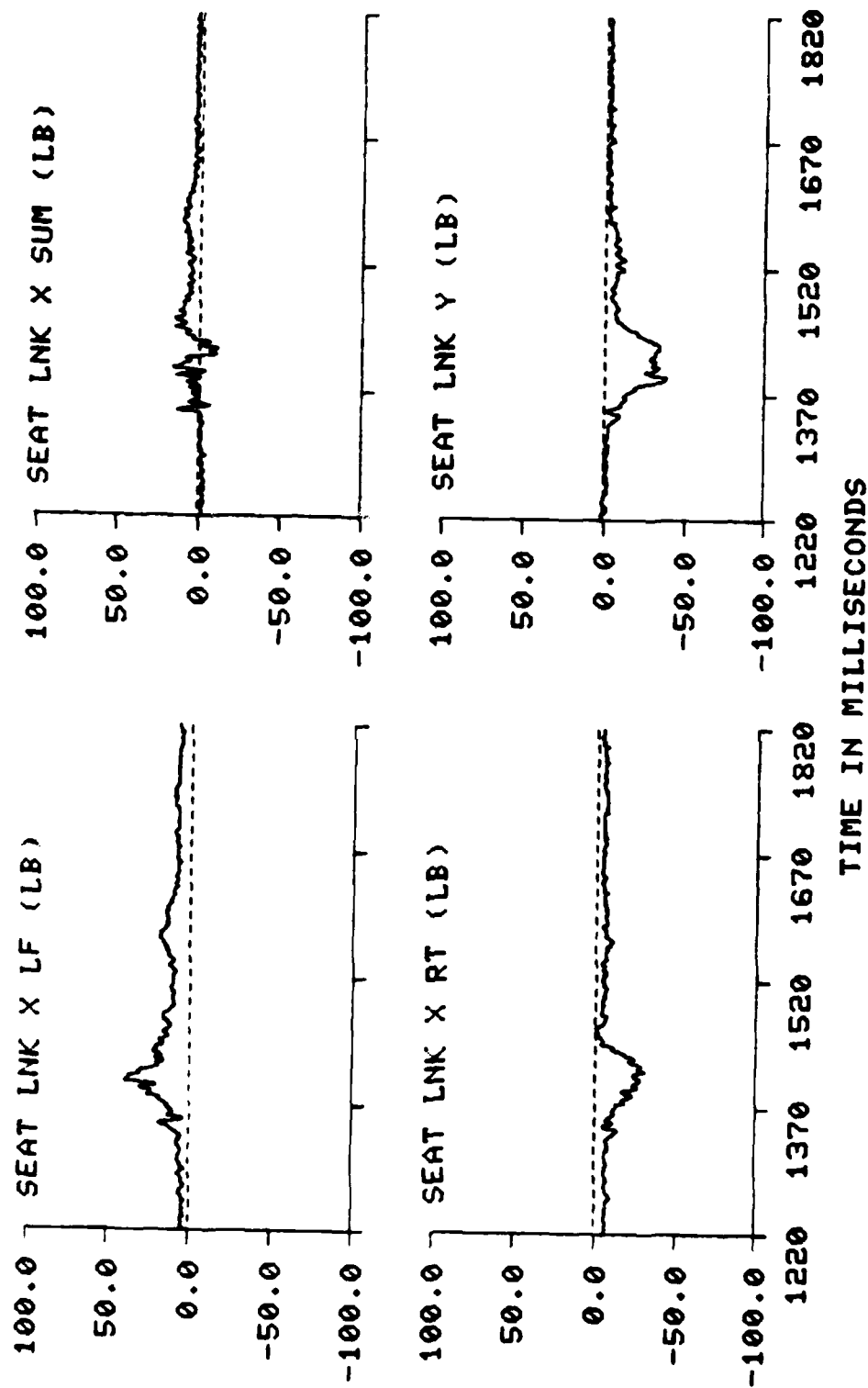
SUBJ ID: R-2



# RESTRAINT CONFIGURATION STUDY

TEST NO: 667

SUBJ ID: R-2



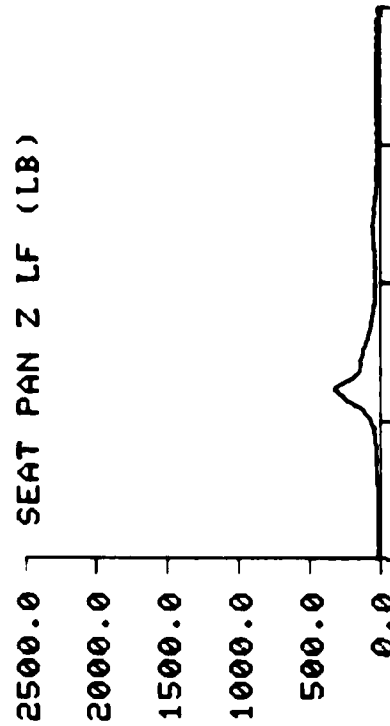
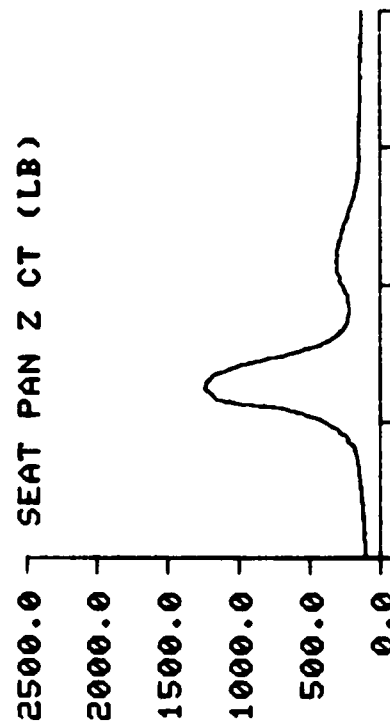
# RESTRAINT CONFIGURATION STUDY

TEST NO: 667

SUBJ ID: R-2

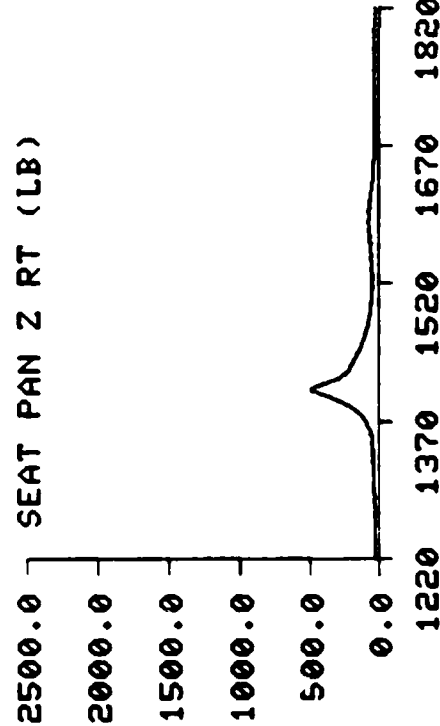
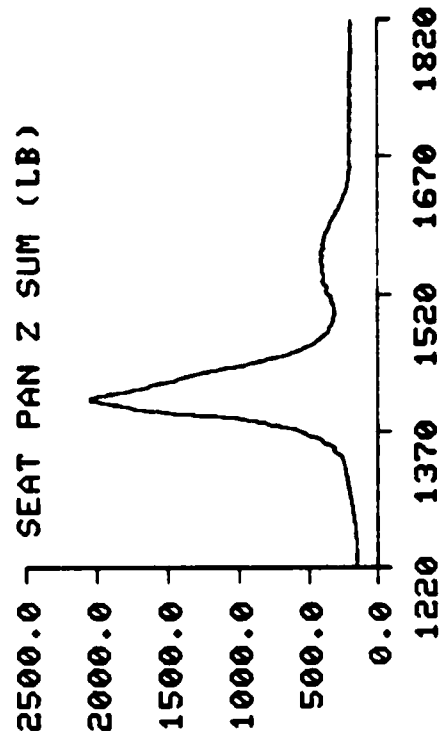
SEAT PAN Z LF (LB)

SEAT PAN Z CT (LB)



SEAT PAN Z RT (LB)

SEAT PAN Z SUM (LB)



TIME IN MILLISECONDS

VERTICAL TEST PHASE      TEST: 664      SUBJ: B-2      WT: 187.0      CELL: H

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1220		
TIME OF IMPACT START				1346		
CARRIAGE ACCELERATION (G)						
X AXIS			2.83	1348	-1.83	1350
Y AXIS			1.74	1396	-1.11	1402
Z AXIS			10.59	1382	-0.13	1302
Z AXIS (SMOOTHED)			9.89	1393	-0.03	1264
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.02	1937	-26.12	1689
TACHOMETER (MEASURED)			-1.18	1765	-26.27	1346
SEAT ACCELERATION (G)						
X AXIS			2.53	1344	-1.57	1390
Y AXIS			1.23	1400	-0.99	1410
Z AXIS			12.40	1382	-0.26	1314
Z AXIS (SMOOTHED)			11.09	1383	-0.14	1314
CHEST ACCELERATION (G)						
X AXIS			1.91	1392	-0.41	1420
Y AXIS			1.61	1450	-0.74	1492
Z AXIS			16.51	1404	-0.99	1316
RESULTANT			16.58	1404	0.60	1344
CHEST SEVERITY INDEX			27.70			
HEAD ACCELERATION (G)						
X AXIS			3.68	1398	-1.48	1452
Y AXIS			0.30	1784	-1.86	1418
Z AXIS			11.35	1394	-0.35	1228
RESULTANT			11.97	1391	0.20	1300
HEAD SEVERITY INDEX			19.72			
NEGATIVE G STRAP	232.62	1325	120.27	1484	33.66	1401
SHOULDER STRAP LOADS (LB)						
X AXIS	134.42	1325	135.42	1437	85.45	1392
Y AXIS	4.86	617	6.03	1631		
Z AXIS	4.06	495	23.87	1422		
RESULTANT	134.56	1328	136.93	1432	86.79	1392
LEFT LAP LOADS (LB)						
X AXIS	85.34	1330	65.40	1408	47.96	1384
Y AXIS	30.51	1329	17.54	1411	11.06	1401
Z AXIS	84.11	1318	39.57	1409	25.39	1383
RESULTANT	129.36	1330	77.66	1408	57.03	1364
RIGHT LAP LOADS (LB)						
X AXIS	65.82	1321	61.99	1405	39.01	1384
Y AXIS	12.70	1315	10.76	1419	2.98	1384
Z AXIS	73.41	1320	37.94	1407	18.13	1363
RESULTANT	98.41	1329	71.92	1407	43.57	1364
TOTAL LAP LOAD (LB)	221.20	1329	149.58	1408	100.60	1384
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	18.22	955	33.46	1345	-18.34	1398
X AXIS (RIGHT)	28.19	514	15.91	1291	-30.29	1368
X AXIS (SUM)	39.73	523	41.18	1345	-44.54	1398
Y AXIS (CENTER)	23.34	725	19.53	1741	-12.22	1394
SEAT LOADS (LB)						
Z AXIS (LEFT)	46.13	485	642.91	1413	15.69	1342
Z AXIS (RIGHT)	57.27	485	691.70	1419	21.08	1245
Z AXIS (CENTER)	335.89	1329	1507.68	1397	190.62	1742
Z AXIS (SUM)	388.58	1328	2456.90	1414	257.56	1742
SEAT Z SUM / WT	2.08	1328	13.14	1414	1.38	1742
RESULTANT SEAT LOAD (LB)	388.74	1328	2456.90	1414	259.33	1742

VERTICAL TEST PHASE      TEST: 654      SUBJ: B-1      WT: 152.0      CELL: H

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1218		
TIME OF IMPACT START				1340		
CARRIAGE ACCELERATION (G)						
X AXIS			2.29	1383	-2.05	1388
Y AXIS			0.99	1342	-0.61	1430
Z AXIS			10.65	1378	-0.12	1290
Z AXIS (SMOOTHED)			10.03	1389	-0.02	1286
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1335	-26.15	1658
TACHOMETER (MEASURED)			-1.18	1725	-26.20	1340
SEAT ACCELERATION (G)						
X AXIS			1.68	1383	-1.98	1387
Y AXIS			1.66	1349	-1.38	1357
Z AXIS			12.42	1382	-0.21	1261
Z AXIS (SMOOTHED)			11.10	1380	-0.15	1258
CHEST ACCELERATION (G)						
X AXIS			2.22	1392	-0.44	1423
Y AXIS			1.01	1441	-1.63	1395
Z AXIS			16.21	1398	-0.68	1296
RESULTANT			16.31	1395	0.28	1336
CHEST SEVERITY INDEX			27.87			
HEAD ACCELERATION (G)						
X AXIS			2.47	1503	-2.98	1421
Y AXIS			1.34	1504	-0.34	1535
Z AXIS			14.21	1402	-0.51	1233
RESULTANT			14.27	1399	0.28	1273
HEAD SEVERITY INDEX			22.02			
NEGATIVE G STRAP	137.34	1324	122.91	1466	17.47	1393
SHOULDER STRAP LOADS (LB)						
X AXIS	89.63	1323	93.63	1460	37.66	1388
Y AXIS	7.75	664	12.40	1409		
Z AXIS	7.58	510	24.92	1379		
RESULTANT	89.95	1325	94.78	1458	44.89	1388
LEFT LAP LOADS (LB)						
X AXIS	90.79	1319	87.05	1403	64.63	1381
Y AXIS	31.43	1324	26.71	1397	20.82	1389
Z AXIS	82.55	1316	56.23	1467	33.96	1361
RESULTANT	126.39	1321	105.54	1402	76.25	1361
RIGHT LAP LOADS (LB)						
X AXIS	86.72	1326	82.89	1404	57.36	1381
Y AXIS	37.49	1326	33.60	1400	20.64	1380
Z AXIS	82.23	1314	58.24	1464	30.08	1380
RESULTANT	124.57	1326	102.12	1404	68.85	1361
TOTAL LAP LOAD (LB)	249.88	1321	206.77	1404	145.10	1361
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	5.49	803	10.36	1436	-26.21	1394
X AXIS (RIGHT)	-2.98	539	-0.64	1452	-36.32	1365
X AXIS (SUM)	0.16	816	4.33	1458	-61.33	1384
Y AXIS (CENTER)	38.05	689	0.58	1676	-37.51	1393
SEAT LOADS (LB)						
Z AXIS (LEFT)	54.91	1327	392.87	1419	31.46	1226
Z AXIS (RIGHT)	98.23	1323	466.86	1395	62.64	1231
Z AXIS (CENTER)	142.71	1326	1090.81	1396	91.29	1212
Z AXIS (SUM)	292.72	1328	1924.38	1396	198.05	1212
SEAT Z SUM / WT	1.93	1326	12.66	1396	1.30	1212
RESULTANT SEAT LOAD (LB)	293.52	1326	1925.48	1396	198.49	1212



VERTICAL TEST PHASE	TEST: 652	SUBJ: B-3	WT: 182.0	CELL: H		
PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1254		
TIME OF IMPACT START				1365		
CARRIAGE ACCELERATION (G)						
X AXIS			2.66	1382	-1.91	1425
Y AXIS			0.62	1381	-0.60	1409
Z AXIS			10.54	1415	-0.11	1256
Z AXIS (SMOOTHED)			10.04	1426	-0.02	1250
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.02	1371	-26.22	1722
TACHOMETER (MEASURED)			-1.15	1849	-25.64	1365
SEAT ACCELERATION (G)						
X AXIS			2.39	1382	-1.73	1425
Y AXIS			1.04	1415	-1.04	1379
Z AXIS			11.46	1421	-0.17	1272
Z AXIS (SMOOTHED)			10.76	1418	-0.13	1267
CHEST ACCELERATION (G)						
X AXIS			9.78	1431	0.00	1375
Y AXIS			0.25	1275	-2.63	1434
Z AXIS			13.24	1438	-0.67	1278
RESULTANT			13.81	1435	0.16	1368
CHEST SEVERITY INDEX			24.60			
HEAD ACCELERATION (G)						
X AXIS			2.42	1437	-1.29	1482
Y AXIS			1.06	1601	-1.42	1521
Z AXIS			11.78	1437	-0.59	1260
RESULTANT			12.05	1434	0.34	1303
HEAD SEVERITY INDEX			19.92			
NEGATIVE G STRAP	270.00	1204	105.56	1522	48.45	1435
SHOULDER STRAP LOADS (LB)						
X AXIS	136.26	1357	108.28	1473	78.29	1434
Y AXIS	15.76	1347	21.00	1457		
Z AXIS	9.39	684	29.20	1453		
RESULTANT	137.21	1364	112.07	1473	84.33	1434
LEFT LAP LOADS (LB)						
X AXIS	117.78	1364	119.02	1441	82.89	1417
Y AXIS	48.62	1363	43.91	1444	32.12	1422
Z AXIS	111.25	1361	86.95	1447	56.58	1418
RESULTANT	166.15	1364	152.67	1443	105.93	1419
RIGHT LAP LOADS (LB)						
X AXIS	126.65	1360	125.37	1441	93.46	1418
Y AXIS	35.05	1193	34.40	1450	24.03	1419
Z AXIS	129.46	1202	99.21	1440	67.92	1418
RESULTANT	184.35	1364	162.64	1441	118.28	1418
TOTAL LAP LOAD (LB)	352.50	1364	314.96	1443	225.37	1418
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	3.35	685	16.76	1379	-16.76	1422
X AXIS (RIGHT)	4.94	981	6.69	1417	-15.53	1470
X AXIS (SUM)	1.10	521	18.77	1379	-23.52	1422
Y AXIS (CENTER)	3.47	560	-0.98	1318	-39.08	1429
SEAT LOADS (LB)						
Z AXIS (LEFT)	71.98	1215	561.12	1438	25.60	1736
Z AXIS (RIGHT)	139.99	1362	615.81	1440	52.51	1846
Z AXIS (CENTER)	330.70	1364	1202.04	1431	197.64	1838
Z AXIS (SUM)	518.15	1364	2330.34	1437	301.63	1826
SEAT Z SUM / WT	2.85	1364	12.80	1437	1.66	1826
RESULTANT SEAT LOAD (LB)	518.37	1364	2330.56	1437	301.74	1826

VERTICAL TEST PHASE      TEST: 686      SUBJ: C-1      WT: 172.0      CELL: H

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1244		
TIME OF IMPACT START				1367		
CARRIAGE ACCELERATION (G)						
X AXIS			2.87	1370	-1.98	1378
Y AXIS			0.48	1408	-0.53	1440
Z AXIS			10.69	1408	-0.11	1254
Z AXIS (SMOOTHED)			10.00	1420	-0.03	1252
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1364	-26.04	1699
TACHOMETER (MEASURED)			-1.20	1753	-26.25	1367
SEAT ACCELERATION (G)						
X AXIS			2.37	1372	-1.70	1414
Y AXIS			1.87	1420	-0.92	1370
Z AXIS			12.79	1412	-0.36	1254
Z AXIS (SMOOTHED)			11.14	1410	-0.22	1250
CHEST ACCELERATION (G)						
X AXIS			2.83	1420	-0.41	1472
Y AXIS			0.55	1372	-2.84	1424
Z AXIS			14.69	1432	-0.60	1266
RESULTANT			15.04	1432	0.16	1362
CHEST SEVERITY INDEX			27.89			
HEAD ACCELERATION (G)						
X AXIS			3.38	1436	-0.53	1370
Y AXIS			0.70	1576	-1.07	1430
Z AXIS			11.49	1434	-0.53	1350
RESULTANT			11.99	1434	0.43	1319
HEAD SEVERITY INDEX			20.22			
NEGATIVE G STRAP	316.33	1353	223.44	1505	84.74	1426
SHOULDER STRAP LOADS (LB)						
X AXIS	203.04	1347	185.05	1501	105.10	1419
Y AXIS	15.38	1355	15.38	1355		
Z AXIS	9.11	726	30.17	1448		
RESULTANT	203.67	1355	187.10	1458	108.32	1419
LEFT LAP LOADS (LB)						
X AXIS	146.68	1352	129.24	1437	104.32	1411
Y AXIS	59.36	1351	48.99	1432	39.32	1415
Z AXIS	139.53	1351	99.04	1461	74.74	1411
RESULTANT	210.14	1355	168.13	1437	134.93	1411
RIGHT LAP LOADS (LB)						
X AXIS	111.97	1354	99.21	1438	73.68	1409
Y AXIS	35.35	1355	30.81	1445	20.44	1410
Z AXIS	119.05	1354	79.42	1436	50.21	1411
RESULTANT	167.08	1354	129.98	1438	91.77	1411
TOTAL LAP LOAD (LB)	376.61	1355	297.44	1436	226.70	1411
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	20.31	512	27.01	1369	0.80	1436
X AXIS (RIGHT)	50.84	512	21.02	1478	-2.96	1414
X AXIS (SUM)	71.15	512	48.03	1478	-0.35	1415
Y AXIS (CENTER)	108.97	512	70.24	1812	17.54	1408
SEAT LOADS (LB)						
Z AXIS (LEFT)	97.52	1354	437.19	1435	48.92	1837
Z AXIS (RIGHT)	105.85	1350	488.95	1433	50.24	1782
Z AXIS (CENTER)	400.10	1355	1353.66	1426	242.76	1836
Z AXIS (SUM)	597.40	1355	2269.51	1427	352.44	1837
SEAT Z SUM / WT	3.47	1355	13.19	1427	2.05	1837
RESULTANT SEAT LOAD (LB)	599.87	1355	2269.66	1427	360.07	1837

VERTICAL TEST PHASE      TEST: 642      SUBJ: C-2      WT: 180.0      CELL: H

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1214		
TIME OF IMPACT START				1340		
CARRIAGE ACCELERATION (G)						
X AXIS			1.95	1340	-1.76	1345
Y AXIS			0.58	1338	-0.50	1342
Z AXIS			10.56	1376	-0.14	1245
Z AXIS (SMOOTHED)			10.01	1382	-0.04	1247
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.02	1330	-26.24	1693
TACHOMETER (MEASURED)			-1.17	1706	-26.19	1340
SEAT ACCELERATION (G)						
X AXIS			1.78	1340	-1.46	1385
Y AXIS			1.10	1388	-0.87	1337
Z AXIS			11.60	1380	-0.18	1312
Z AXIS (SMOOTHED)			10.89	1378	-0.07	1230
CHEST ACCELERATION (G)						
X AXIS			3.32	1388	-0.49	1446
Y AXIS			0.93	1454	-2.07	1397
Z AXIS			14.22	1395	-0.57	1287
RESULTANT			14.54	1394	0.17	1306
CHEST SEVERITY INDEX			28.24			
HEAD ACCELERATION (G)						
X AXIS			2.45	1392	-2.94	1450
Y AXIS			2.43	1439	0.63	1493
Z AXIS			10.69	1397	-0.70	1273
RESULTANT			11.02	1394	0.69	1766
HEAD SEVERITY INDEX			19.79			
NEGATIVE G STRAP	170.67	1326	194.52	1451	80.30	1381
SHOULDER STRAP LOADS (LB)						
X AXIS	75.38	1326	189.31	1435	56.39	1386
Y AXIS	5.85	1315	16.32	1407		
Z AXIS	7.33	1309	42.00	1421		
RESULTANT	75.92	1326	193.41	1435	63.10	1370
LEFT LAP LOADS (LB)						
X AXIS	69.19	1325	100.34	1410	66.70	1356
Y AXIS	26.78	1321	37.98	1410	24.42	1357
Z AXIS	65.57	1326	75.69	1439	40.25	1378
RESULTANT	97.99	1326	129.00	1410	83.58	1378
RIGHT LAP LOADS (LB)						
X AXIS	69.21	1326	98.57	1420	61.55	1358
Y AXIS	15.28	1324	20.47	1426	10.10	1377
Z AXIS	69.09	1324	80.56	1431	40.93	1377
RESULTANT	98.88	1326	127.54	1420	75.94	1378
TOTAL LAP LOAD (LB)	196.87	1326	254.58	1409	159.53	1378
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	2.72	950	14.30	1465	-18.61	1382
X AXIS (RIGHT)	-0.65	520	-4.16	1620	-53.87	1392
X AXIS (SUM)	-1.49	961	1.95	1465	-69.56	1382
Y AXIS (CENTER)	3.51	884	2.87	1212	-30.15	1376
SEAT LOADS (LB)						
Z AXIS (LEFT)	45.15	1298	399.35	1416	24.10	1315
Z AXIS (RIGHT)	56.93	1314	514.60	1426	34.67	1210
Z AXIS (CENTER)	195.74	1326	1316.50	1394	86.91	1223
Z AXIS (SUM)	286.10	1326	2148.73	1395	155.11	1216
SEAT Z SUM / WT	1.59	1326	11.94	1395	0.86	1216
RESULTANT SEAT LOAD (LB)	287.17	1326	2149.74	1395	155.44	1216

VERTICAL TEST PHASE	TEST: 656	SUBJ: E-2	WT: 167.0	CELL: H		
PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1188		
TIME OF IMPACT START				1308		
CARRIAGE ACCELERATION (G)						
X AXIS			2.82	1312	-1.67	1359
Y AXIS			0.41	1312	-0.76	1358
Z AXIS			10.44	1350	-0.14	1224
Z AXIS (SMOOTHED)			10.04	1361	-0.03	1217
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.00	1309	-26.12	1651
TACHOMETER (MEASURED)			-1.21	1658	-26.20	1308
SEAT ACCELERATION (G)						
X AXIS			2.40	1312	-1.77	1359
Y AXIS			1.62	1362	-0.50	1327
Z AXIS			11.59	1367	-0.09	1243
Z AXIS (SMOOTHED)			10.98	1352	-0.02	1219
CHEST ACCELERATION (G)						
X AXIS			2.29	1359	-1.77	1413
Y AXIS			0.98	1460	-0.91	1376
Z AXIS			14.61	1375	-0.99	1263
RESULTANT			14.65	1372	0.32	1308
CHEST SEVERITY INDEX			23.21			
HEAD ACCELERATION (G)						
X AXIS			3.57	1364	-0.24	1310
Y AXIS			1.62	1477	0.27	1453
Z AXIS			10.68	1363	-0.67	1272
RESULTANT			11.27	1360	0.50	1448
HEAD SEVERITY INDEX			18.39			
NEGATIVE G STRAP	319.71	1298	244.40	1419	151.52	1366
SHOULDER STRAP LOADS (LB)						
X AXIS	203.68	1299	313.62	1402	178.70	1351
Y AXIS	3.18	772	18.30	1416		
Z AXIS	15.58	1067	58.92	1393		
RESULTANT	203.78	1299	319.34	1402	181.71	1351
LEFT LAP LOADS (LB)						
X AXIS	111.30	1298	118.77	1405	81.40	1352
Y AXIS	43.86	1296	49.76	1406	31.48	1359
Z AXIS	102.22	1297	98.17	1405	53.62	1353
RESULTANT	156.31	1297	161.57	1405	104.44	1352
RIGHT LAP LOADS (LB)						
X AXIS	95.43	1297	112.02	1405	72.45	1351
Y AXIS	33.64	1289	39.47	1399	23.91	1350
Z AXIS	99.42	1299	103.59	1408	48.31	1353
RESULTANT	141.85	1299	155.85	1407	90.31	1353
TOTAL LAP LOAD (LB)	296.71	1297	317.32	1405	194.86	1353
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	-3.36	500	7.00	1439	-42.37	1356
X AXIS (RIGHT)	-0.41	536	-6.26	1435	-47.78	1357
X AXIS (SUM)	-4.94	501	-2.18	1439	-89.56	1356
Y AXIS (CENTER)	1.41	485	0.77	1751	-32.88	1353
SEAT LOADS (LB)						
Z AXIS (LEFT)	62.18	453	378.10	1400	29.31	1586
Z AXIS (RIGHT)	60.81	453	417.21	1392	7.94	1226
Z AXIS (CENTER)	413.51	1299	1417.27	1367	181.97	1780
Z AXIS (SUM)	484.18	1299	1966.45	1368	309.12	1773
SEAT Z SUM / WT	2.90	1299	11.78	1368	1.85	1773
RESULTANT SEAT LOAD (LB)	486.30	1299	1968.16	1368	309.62	1773

VERTICAL TEST PHASE      TEST: 662      SUBJ: H-6      WT: 188.0      CELL: H

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1180		
TIME OF IMPACT START				1312		
CARRIAGE ACCELERATION (G)						
X AXIS			1.57	1346	-1.61	1348
Y AXIS			0.26	1520	-0.64	1370
Z AXIS			10.60	1341	-0.11	1194
Z AXIS (SMOOTHED)			10.03	1353	-0.02	1195
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1299	-26.24	1650
TACHOMETER (MEASURED)			-1.21	1647	-26.26	1312
SEAT ACCELERATION (G)						
X AXIS			1.30	1346	-1.64	1350
Y AXIS			1.30	1350	-0.80	1358
Z AXIS			11.51	1342	-0.32	1200
Z AXIS (SMOOTHED)			10.73	1343	-0.22	1196
CHEST ACCELERATION (G)						
X AXIS			3.87	1350	-0.45	1402
Y AXIS			1.42	1446	-1.16	1360
Z AXIS			14.01	1362	-0.78	1268
RESULTANT			14.33	1362	0.61	1183
CHEST SEVERITY INDEX			26.76			
HEAD ACCELERATION (G)						
X AXIS			4.50	1352	-0.31	1452
Y AXIS			1.04	1402	-0.66	1364
Z AXIS			10.09	1354	-0.56	1204
RESULTANT			11.04	1351	0.45	1445
HEAD SEVERITY INDEX			19.32			
NEGATIVE G STRAP	326.48	1282	234.22	1438	109.96	1357
SHOULDER STRAP LOADS (LB)						
X AXIS	171.30	1283	233.33	1399	100.40	1349
Y AXIS	2.51	1279	14.15	1395		
Z AXIS	17.91	780	57.53	1395		
RESULTANT	171.78	1289	240.12	1398	105.63	1349
LEFT LAP LOADS (LB)						
X AXIS	94.75	1253	112.19	1384	67.35	1343
Y AXIS	37.39	1264	38.57	1386	22.66	1348
Z AXIS	95.11	1254	87.01	1396	43.47	1342
RESULTANT	138.36	1258	146.02	1387	83.63	1344
RIGHT LAP LOADS (LB)						
X AXIS	104.72	1281	128.97	1385	77.92	1342
Y AXIS	34.15	1258	36.10	1388	21.19	1341
Z AXIS	109.96	1278	112.04	1393	55.72	1344
RESULTANT	155.36	1281	173.02	1385	98.84	1343
TOTAL LAP LOAD (LB)	292.18	1281	318.89	1387	183.00	1343
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	18.28	798	31.08	1429	-8.53	1348
X AXIS (RIGHT)	21.82	462	18.32	1449	-27.88	1357
X AXIS (SUM)	35.89	447	44.13	1429	-31.74	1348
Y AXIS (CENTER)	47.75	477	41.40	1770	1.40	1341
SEAT LOADS (LB)						
Z AXIS (LEFT)	75.57	445	417.67	1371	32.55	1614
Z AXIS (RIGHT)	86.12	1150	495.25	1368	51.68	1646
Z AXIS (CENTER)	375.72	1289	1425.68	1357	193.58	1777
Z AXIS (SUM)	504.73	1289	2259.57	1365	340.67	1615
SEAT Z SUM / WT	2.68	1289	12.02	1365	1.81	1615
RESULTANT SEAT LOAD (LB)	505.73	1289	2259.65	1365	343.44	1615

VERTICAL TEST PHASE	TEST: 696	SUBJ: J-4	WT: 188.0	CELL: H		
PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1232		
TIME OF IMPACT START				1357		
CARRIAGE ACCELERATION (G)						
X AXIS			1.82	1398	-2.10	1406
Y AXIS			1.66	1410	-0.54	1460
Z AXIS			10.79	1396	-0.08	1298
Z AXIS (SMOOTHED)			8.93	1408	-0.02	1230
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.02	1351	-26.20	1680
TACHOMETER (MEASURED)			-1.12	1809	-26.36	1357
SEAT ACCELERATION (G)						
X AXIS			1.55	1410	-1.79	1402
Y AXIS			1.40	1418	-1.39	1450
Z AXIS			12.85	1400	-0.40	1252
Z AXIS (SMOOTHED)			11.06	1398	-0.24	1248
CHEST ACCELERATION (G)						
X AXIS			2.00	1412	-1.06	1458
Y AXIS			0.49	1432	-2.44	1412
Z AXIS			15.96	1422	-1.55	1506
RESULTANT			16.16	1419	0.06	1350
CHEST SEVERITY INDEX			30.15			
HEAD ACCELERATION (G)						
X AXIS			3.92	1486	-2.29	1472
Y AXIS			2.19	1504	-0.53	1454
Z AXIS			12.45	1418	-1.33	1510
RESULTANT			13.05	1417	0.27	1353
HEAD SEVERITY INDEX			24.10			
NEGATIVE G STRAP	210.25	1344	154.39	1510	42.05	1412
SHOULDER STRAP LOADS (LB)						
X AXIS	134.94	1338	148.93	1459	57.99	1406
Y AXIS	5.29	788	12.86	1461		
Z AXIS	-3.89	499	14.69	1434		
RESULTANT	136.44	1344	149.39	1459	59.26	1407
LEFT LAP LOADS (LB)						
X AXIS	97.92	1341	114.11	1430	76.74	1398
Y AXIS	28.55	1344	28.55	1428	19.71	1401
Z AXIS	93.59	1344	79.42	1431	44.99	1397
RESULTANT	136.43	1344	141.93	1428	91.24	1399
RIGHT LAP LOADS (LB)						
X AXIS	77.40	1343	102.93	1429	60.81	1398
Y AXIS	19.23	1343	23.77	1434	11.46	1397
Z AXIS	79.46	1342	81.54	1428	39.62	1395
RESULTANT	111.85	1343	132.14	1428	74.16	1398
TOTAL LAP LOAD (LB)	250.03	1344	274.07	1428	165.67	1398
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	3.01	1335	28.61	1407	-7.96	1438
X AXIS (RIGHT)	2.16	514	3.92	1470	-35.85	1402
X AXIS (SUM)	0.32	501	10.10	1483	-31.84	1430
Y AXIS (CENTER)	-2.65	557	-3.92	1230	-54.72	1436
SEAT LOADS (LB)						
Z AXIS (LEFT)	113.91	1338	660.22	1416	53.46	1706
Z AXIS (RIGHT)	104.62	1343	730.29	1414	52.12	1726
Z AXIS (CENTER)	241.54	667	1173.21	1417	153.30	1241
Z AXIS (SUM)	418.47	1343	2557.92	1416	297.70	1232
SEAT Z SUM / WT	2.23	1343	13.61	1416	1.58	1232
RESULTANT SEAT LOAD (LB)	418.61	1343	2558.23	1416	297.77	1232

VERTICAL TEST PHASE

TEST: 697

SUBJ: K-1

WT: 183.0

CELL: H

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK						
TIME OF IMPACT START				1228 1347		
CARRIAGE ACCELERATION (G)						
X AXIS			1.19	1392	-1.72	1396
Y AXIS			2.03	1404	-0.68	1410
Z AXIS			10.73	1389	-0.12	1292
Z AXIS (SMOOTHED)			9.94	1401	-0.03	1291
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.02	1343	-26.09	1667
TACHOMETER (MEASURED)			-1.12	1720	-26.36	1347
SEAT ACCELERATION (G)						
X AXIS			1.26	1400	-1.57	1396
Y AXIS			1.85	1408	-0.94	1480
Z AXIS			12.25	1390	-0.29	1240
Z AXIS (SMOOTHED)			10.86	1390	-0.17	1237
CHEST ACCELERATION (G)						
X AXIS			3.17	1408	-0.32	1452
Y AXIS			1.08	1486	-3.52	1414
Z AXIS			15.49	1422	-0.64	1260
RESULTANT			15.93	1419	0.18	1341
CHEST SEVERITY INDEX			30.01			
HEAD ACCELERATION (G)						
X AXIS			2.19	1408	-2.13	1454
Y AXIS			1.41	1596	-0.22	1422
Z AXIS			12.49	1412	-0.86	1324
RESULTANT			12.63	1409	0.73	1349
HEAD SEVERITY INDEX			19.92			
NEGATIVE G STRAP	220.80	1333	93.40	1471	18.09	1407
SHOULDER STRAP LOADS (LB)						
X AXIS	150.61	1333	136.62	1450	74.66	1399
Y AXIS	4.03	527	8.68	1526		
Z AXIS	7.16	1096	28.21	1426		
RESULTANT	150.62	1333	138.51	1450	77.98	1394
LEFT LAP LOADS (LB)						
X AXIS	107.34	1333	91.14	1421	55.01	1392
Y AXIS	34.16	1322	24.73	1421	15.30	1347
Z AXIS	97.30	1327	57.81	1420	27.44	1364
RESULTANT	147.81	1332	110.20	1421	64.24	1392
RIGHT LAP LOADS (LB)						
X AXIS	78.94	1319	68.73	1416	41.92	1391
Y AXIS	18.82	1266	14.93	1410	7.15	1385
Z AXIS	72.57	1288	40.24	1417	15.21	1344
RESULTANT	108.55	1319	79.47	1416	45.27	1391
TOTAL LAP LOAD (LB)	255.00	1334	187.70	1418	111.16	1392
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	41.55	495	42.16	1400	14.13	1415
X AXIS (RIGHT)	0.54	509	1.12	1512	-56.19	1406
X AXIS (SUM)	40.26	509	33.10	1478	-31.14	1400
Y AXIS (CENTER)	-15.56	584	-18.73	1743	-80.32	1427
SEAT LOADS (LB)						
Z AXIS (LEFT)	102.79	1316	443.13	1407	32.24	1407
Z AXIS (RIGHT)	82.80	1338	507.25	1406	32.41	1406
Z AXIS (CENTER)	253.70	1338	1370.39	1406	129.81	1391
Z AXIS (SUM)	439.29	1338	2319.77	1407	227.55	1407
SEAT Z SUM / WT	2.36	1338	12.67	1407	1.24	1391
RESULTANT SEAT LOAD (LB)	432.61	1338	2320.32	1407	229.64	1391

VERTICAL TEST PHASE      TEST: 644      SUBJ: M13      WT: 173.0      CELL: H

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1180		
TIME OF IMPACT START				1303		
CARRIAGE ACCELERATION (G)						
X AXIS			2.13	1307	-1.62	1312
Y AXIS			1.59	1358	-0.51	1406
Z AXIS			10.54	1342	-0.02	1272
Z AXIS (SMOOTHED)			10.04	1348	0.00	1241
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.00	1302	-26.28	1657
TACHOMETER (MEASURED)			-1.19	1744	-26.02	1303
SEAT ACCELERATION (G)						
X AXIS			1.85	1306	-1.61	1351
Y AXIS			1.61	1364	-0.91	1346
Z AXIS			11.47	1346	-0.19	1196
Z AXIS (SMOOTHED)			10.87	1345	-0.11	1193
CHEST ACCELERATION (G)						
X AXIS			2.47	1354	-0.98	1407
Y AXIS			0.77	1407	-1.42	1365
Z AXIS			15.98	1361	-0.72	1198
RESULTANT			16.13	1358	0.44	1190
CHEST SEVERITY INDEX			25.67			
HEAD ACCELERATION (G)						
X AXIS			3.37	1366	-0.15	1305
Y AXIS			1.25	1665	-0.13	1382
Z AXIS			12.07	1369	-0.73	1232
RESULTANT			12.50	1366	0.80	1603
HEAD SEVERITY INDEX			19.52			
NEGATIVE G STRAP	170.01	1282	110.38	1432	28.17	1360
SHOULDER STRAP LOADS (LB)						
X AXIS	115.97	1289	142.96	1397	67.00	1353
Y AXIS	11.67	751	12.83	1386		
Z AXIS	-0.69	446	20.36	1362		
RESULTANT	116.51	1289	143.88	1395	69.59	1353
LEFT LAP LOADS (LB)						
X AXIS	143.66	1287	143.66	1368	121.24	1345
Y AXIS	46.56	1282	42.44	1372	38.90	1335
Z AXIS	122.30	1277	98.00	1369	78.77	1344
RESULTANT	193.56	1287	177.87	1369	150.95	1345
RIGHT LAP LOADS (LB)						
X AXIS	124.74	1291	132.40	1367	108.14	1344
Y AXIS	36.51	1276	42.35	1364	31.33	1343
Z AXIS	112.12	1282	93.35	1369	72.49	1344
RESULTANT	169.89	1291	166.38	1367	133.91	1344
TOTAL LAP LOAD (LB)	363.16	1291	343.82	1369	285.10	1344
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	45.27	446	26.38	1519	0.17	1359
X AXIS (RIGHT)	36.27	447	35.10	1415	2.94	1348
X AXIS (SUM)	80.37	446	53.75	1437	9.20	1348
Y AXIS (CENTER)	-41.26	506	-45.71	1757	-106.03	1346
SEAT LOADS (LB)						
Z AXIS (LEFT)	75.53	445	431.26	1375	35.12	1671
Z AXIS (RIGHT)	101.83	445	433.90	1371	50.16	1643
Z AXIS (CENTER)	257.09	1290	1303.52	1359	162.96	1180
Z AXIS (SUM)	404.38	1290	2113.67	1361	291.54	1748
SEAT Z SUM / WT	2.34	1290	12.22	1361	1.69	1748
RESULTANT SEAT LOAD (LB)	409.24	1290	2115.78	1361	298.67	1748



VERTICAL TEST PHASE      TEST: 705      SUBJ: P-3      WT: 206.0      CELL: H

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK						
TIME OF IMPACT START				1222 1347		
CARRIAGE ACCELERATION (G)						
X AXIS			1.44	1386	-1.84	1394
Y AXIS			1.07	1400	-0.47	1372
Z AXIS			10.65	1384	-0.12	1306
Z AXIS (SMOOTHED)			9.88	1389	-0.03	1221
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1341	-25.97	1668
TACHOMETER (MEASURED)			-1.12	1726	-26.42	1347
SEAT ACCELERATION (G)						
X AXIS			1.23	1398	-1.69	1394
Y AXIS			1.45	1404	-0.96	1472
Z AXIS			12.55	1388	-0.13	1294
Z AXIS (SMOOTHED)			10.95	1385	-0.09	1290
CHEST ACCELERATION (G)						
X AXIS			4.36	1404	-0.19	1458
Y AXIS			1.20	1588	-1.47	1410
Z AXIS			15.08	1410	-0.86	1334
RESULTANT			15.66	1407	0.42	1222
CHEST SEVERITY INDEX			28.01			
HEAD ACCELERATION (G)						
X AXIS			1.71	1398	-2.10	1444
Y AXIS			0.76	1524	-0.48	1430
Z AXIS			12.10	1400	-0.62	1294
RESULTANT			12.22	1398	0.38	1634
22.01						
NEGATIVE G STRAP	284.54	1333	221.15	1456	91.87	1401
SHOULDER STRAP LOADS (LB)						
X AXIS	176.70	1331	203.68	1444	92.75	1395
Y AXIS	-2.98	493	-0.07	1814		
Z AXIS	-5.84	487	5.30	1396		
RESULTANT	182.10	1333	204.56	1444	93.34	1395
LEFT LAP LOADS (LB)						
X AXIS	113.29	1333	124.50	1415	97.10	1387
Y AXIS	28.21	1331	31.74	1411	22.31	1390
Z AXIS	101.57	1332	93.47	1450	64.11	1386
RESULTANT	154.84	1333	156.19	1415	119.84	1386
RIGHT LAP LOADS (LB)						
X AXIS	106.53	1332	119.30	1415	87.39	1387
Y AXIS	29.36	1330	29.36	1416	20.28	1385
Z AXIS	107.74	1333	94.18	1452	61.85	1384
RESULTANT	153.49	1332	154.68	1415	110.24	1386
TOTAL LAP LOAD (LB)	307.22	1332	310.87	1415	230.07	1386
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	1.79	1319	17.03	1467	-20.15	1406
X AXIS (RIGHT)	-2.63	564	-6.14	1570	-49.42	1391
X AXIS (SUM)	-6.91	528	2.70	1467	-61.84	1401
Y AXIS (CENTER)	0.86	505	0.86	1770	-46.12	1384
SEAT LOADS (LB)						
Z AXIS (LEFT)	119.62	1317	597.49	1403	64.03	1224
Z AXIS (RIGHT)	92.30	1327	601.87	1409	50.56	1222
Z AXIS (CENTER)	320.69	1333	1494.61	1402	139.94	1800
Z AXIS (SUM)	525.11	1333	2672.47	1403	262.83	1222
SEAT Z SUM / WT	2.55	1333	12.97	1403	1.28	1222
RESULTANT SEAT LOAD (LB)	525.63	1333	2673.33	1403	263.18	1222

VERTICAL TEST PHASE		TEST: 715	SUBJ: A-2	WT: 143.0	CELL: H	
PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1184		
TIME OF IMPACT START				1314		
CARRIAGE ACCELERATION (G)						
X AXIS			3.34	1310	-2.04	1318
Y AXIS			0.34	1514	-0.55	1400
Z AXIS			10.70	1347	-0.07	1270
Z AXIS (SMOOTHED)			10.02	1360	-0.02	1270
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1305	-26.25	1638
TACHOMETER (MEASURED)			-1.20	1671	-26.25	1314
SEAT ACCELERATION (G)						
X AXIS			2.84	1312	-1.74	1318
Y AXIS			1.90	1356	-0.77	1366
Z AXIS			12.75	1352	-0.04	1270
Z AXIS (SMOOTHED)			11.17	1349	0.01	1270
CHEST ACCELERATION (G)						
X AXIS			2.65	1356	-0.39	1380
Y AXIS			0.16	1410	-3.34	1360
Z AXIS			13.72	1376	-0.77	1282
RESULTANT			13.79	1375	0.44	1302
CHEST SEVERITY INDEX			26.94			
HEAD ACCELERATION (G)						
X AXIS			1.10	1430	-3.00	1366
Y AXIS			1.08	1454	-0.16	1414
Z AXIS			12.29	1366	-0.59	1276
RESULTANT			12.32	1365	0.61	1262
HEAD SEVERITY INDEX			21.13			
NEGATIVE G STRAP	127.37	1294	91.59	1453	18.16	1363
SHOULDER STRAP LOADS (LB)						
X AXIS	75.54	1295	110.52	1387	56.55	1355
Y AXIS	4.32	1179	14.79	1377		
Z AXIS	13.67	1292	42.15	1382		
RESULTANT	76.40	1295	118.14	1387	63.42	1355
LEFT LAP LOADS (LB)						
X AXIS	100.06	1294	100.06	1369	76.39	1334
Y AXIS	37.13	1292	34.77	1367	27.11	1343
Z AXIS	88.67	1293	63.36	1370	42.10	1346
RESULTANT	138.76	1294	122.95	1369	92.56	1350
RIGHT LAP LOADS (LB)						
X AXIS	100.74	1296	91.80	1370	67.55	1349
Y AXIS	40.89	1296	38.30	1369	26.64	1335
Z AXIS	98.46	1291	67.17	1369	43.18	1351
RESULTANT	145.29	1296	120.03	1369	85.02	1344
TOTAL LAP LOAD (LB)	284.05	1296	242.98	1369	178.40	1349
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	0.61	798	38.40	1359	-3.66	1295
X AXIS (RIGHT)	-0.23	468	3.86	1311	-17.19	1355
X AXIS (SUM)	-0.62	467	29.39	1359	-14.33	1301
Y AXIS (CENTER)	0.19	528	-2.98	1680	-58.20	1363
SEAT LOADS (LB)						
Z AXIS (LEFT)	43.67	1295	360.55	1359	21.41	1191
Z AXIS (RIGHT)	45.67	1291	432.71	1364	19.44	1194
Z AXIS (CENTER)	222.82	1296	1211.20	1366	139.40	1774
Z AXIS (SUM)	310.47	1296	1957.14	1364	191.65	1185
SEAT Z SUM / WT	2.17	1296	13.69	1364	1.34	1185
RESULTANT SEAT LOAD (LB)	311.01	1296	1958.04	1364	192.01	1187

VERTICAL TEST PHASE      TEST: 641      SUBJ: R-3      WT: 155.0      CELL: H

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1188		
TIME OF IMPACT START				1315		
CARRIAGE ACCELERATION (G)						
X AXIS			1.60	1354	-1.50	1359
Y AXIS			0.59	1365	-0.51	1312
Z AXIS			10.76	1349	-0.04	1283
Z AXIS (SMOOTHED)			10.00	1354	-0.03	1217
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.02	1303	-26.17	1661
TACHOMETER (MEASURED)			-1.19	1663	-26.18	1315
SEAT ACCELERATION (G)						
X AXIS			1.32	1354	-1.53	1358
Y AXIS			0.92	1361	-0.48	1366
Z AXIS			11.48	1353	-0.11	1202
Z AXIS (SMOOTHED)			10.91	1351	-0.07	1180
CHEST ACCELERATION (G)						
X AXIS			9.11	1375	-0.21	1460
Y AXIS			0.52	1393	-1.01	1376
Z AXIS			17.48	1378	-0.72	1204
RESULTANT			17.77	1373	0.33	1767
CHEST SEVERITY INDEX			27.58			
HEAD ACCELERATION (G)						
X AXIS			0.76	1361	-2.49	1414
Y AXIS			0.61	1365	-0.15	1739
Z AXIS			12.93	1372	-0.53	1305
RESULTANT			12.95	1369	0.22	1261
HEAD SEVERITY INDEX			19.91			
NEGATIVE G STRAP	217.48	1297	116.43	1445	36.73	1366
SHOULDER STRAP LOADS (LB)						
X AXIS	79.49	1295	151.45	1400	51.51	1359
Y AXIS	6.71	813	5.55	1186		
Z AXIS	13.40	606	49.31	1393		
RESULTANT	80.63	1297	158.92	1400	59.42	1360
LEFT LAP LOADS (LB)						
X AXIS	131.95	1296	117.00	1368	98.32	1351
Y AXIS	55.63	1295	45.02	1371	39.12	1354
Z AXIS	126.47	1297	85.98	1369	70.79	1352
RESULTANT	190.21	1296	150.88	1369	127.68	1352
RIGHT LAP LOADS (LB)						
X AXIS	131.14	1294	109.44	1366	95.40	1351
Y AXIS	52.68	1296	41.66	1369	36.47	1350
Z AXIS	136.51	1295	87.49	1371	71.84	1352
RESULTANT	196.49	1296	145.56	1369	124.87	1352
TOTAL LAP LOAD (LB)	386.70	1296	296.44	1369	252.55	1352
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	17.06	624	20.72	1317	-6.70	1376
X AXIS (RIGHT)	23.30	453	10.43	1618	-17.05	1365
X AXIS (SUM)	30.64	454	27.06	1317	-18.88	1367
Y AXIS (CENTER)	-33.70	514	-40.69	1708	-113.08	1364
SEAT LOADS (LB)						
Z AXIS (LEFT)	82.42	1295	338.19	1365	26.79	1635
Z AXIS (RIGHT)	110.09	1296	420.30	1366	31.04	1671
Z AXIS (CENTER)	262.70	1297	1281.67	1366	150.64	1777
Z AXIS (SUM)	455.21	1297	2039.54	1366	221.67	1768
SEAT Z SUM / WT	2.94	1297	13.16	1366	1.43	1768
RESULTANT SEAT LOAD (LB)	457.88	1297	2042.58	1366	226.93	1768

VERTICAL TEST PHASE      TEST: 716      SUBJ: S-6      WT: 117.0      CELL: H

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1196		
TIME OF IMPACT START				1318		
CARRIAGE ACCELERATION (G)						
X AXIS			1.57	1362	-2.04	1366
Y AXIS			1.02	1378	-0.54	1394
Z AXIS			10.83	1359	-0.14	1254
Z AXIS (SMOOTHED)			10.04	1364	-0.03	1232
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1314	-26.19	1670
TACHOMETER (MEASURED)			-1.17	1685	-26.22	1318
SEAT ACCELERATION (G)						
X AXIS			1.49	1370	-1.85	1366
Y AXIS			1.45	1372	-1.39	1318
Z AXIS			12.25	1364	-0.40	1210
Z AXIS (SMOOTHED)			11.19	1361	-0.21	1210
CHEST ACCELERATION (G)						
X AXIS			1.20	1364	-1.34	1398
Y AXIS			0.37	1396	-1.22	1376
Z AXIS			13.73	1384	-0.46	1254
RESULTANT			13.76	1381	0.22	1279
CHEST SEVERITY INDEX			24.16			
HEAD ACCELERATION (G)						
X AXIS			1.89	1368	-2.57	1424
Y AXIS			1.49	1740	-0.65	1368
Z AXIS			10.81	1380	-1.48	1740
RESULTANT			10.95	1379	0.63	1677
HEAD SEVERITY INDEX			17.17			
NEGATIVE G STRAP	128.08	1307	114.27	1454	32.06	1375
SHOULDER STRAP LOADS (LB)						
X AXIS	70.94	1308	140.40	1419	61.94	1369
Y AXIS	6.39	1201	9.88	1377		
Z AXIS	22.86	1233	64.96	1403		
RESULTANT	74.08	1308	153.31	1417	71.69	1344
LEFT LAP LOADS (LB)						
X AXIS	66.47	1308	85.16	1388	54.02	1351
Y AXIS	24.16	1300	27.11	1388	14.73	1352
Z AXIS	60.58	1307	52.48	1391	21.10	1361
RESULTANT	92.09	1307	103.14	1386	60.99	1361
RIGHT LAP LOADS (LB)						
X AXIS	76.59	1306	107.22	1385	71.48	1340
Y AXIS	32.22	1308	42.59	1384	26.34	1362
Z AXIS	76.18	1294	79.31	1391	48.02	1360
RESULTANT	111.84	1306	139.22	1385	90.46	1361
TOTAL LAP LOAD (LB)	203.77	1307	241.54	1385	151.44	1361
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	-1.30	552	17.59	1448	-23.85	1383
X AXIS (RIGHT)	26.67	462	17.31	1471	-7.64	1313
X AXIS (SUM)	23.53	465	29.64	1448	-21.53	1360
Y AXIS (CENTER)	43.88	463	28.00	1471	-2.48	1373
SEAT LOADS (LB)						
Z AXIS (LEFT)	23.81	462	249.28	1378	-10.16	1314
Z AXIS (RIGHT)	38.09	1297	231.87	1410	22.03	1634
Z AXIS (CENTER)	177.72	1308	997.51	1376	103.28	1777
Z AXIS (SUM)	212.31	1306	1477.75	1376	147.32	1194
SEAT Z SUM / WT	1.81	1308	12.63	1376	1.28	1194
RESULTANT SEAT LOAD (LB)	213.95	1308	1477.82	1376	149.51	1194

VERTICAL TEST PHASE      TEST: 673      SUBJ: W-3      WT: 175.0      CELL: H

PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1244		
TIME OF IMPACT START				1369		
CARRIAGE ACCELERATION (G)						
X AXIS			2.54	1370	-1.80	1372
Y AXIS			1.56	1416	-0.84	1422
Z AXIS			10.57	1405	-0.08	1276
Z AXIS (SMOOTHED)			9.96	1410	-0.01	1275
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.02	1361	-26.28	1697
TACHOMETER (MEASURED)			-1.17	1825	-26.25	1369
SEAT ACCELERATION (G)						
X AXIS			2.23	1366	-1.72	1414
Y AXIS			1.01	1418	-1.10	1406
Z AXIS			11.57	1406	-0.23	1334
Z AXIS (SMOOTHED)			10.84	1407	-0.16	1305
CHEST ACCELERATION (G)						
X AXIS			1.08	1414	-1.53	1468
Y AXIS			1.08	1436	-0.53	1840
Z AXIS			14.59	1418	-0.70	1520
RESULTANT			14.59	1418	0.51	1360
CHEST SEVERITY INDEX			28.73			
HEAD ACCELERATION (G)						
X AXIS			1.82	1548	-2.76	1470
Y AXIS			0.73	1532	-0.69	1466
Z AXIS			11.22	1434	-0.33	1296
RESULTANT			11.24	1431	0.43	1281
HEAD SEVERITY INDEX			21.65			
NEGATIVE G STRAP	194.13	1343	168.40	1483	25.31	1421
SHOULDER STRAP LOADS (LB)						
X AXIS	162.39	1349	217.35	1464	102.42	1415
Y AXIS	7.88	724	9.04	1649		
Z AXIS	3.79	511	29.79	1447		
RESULTANT	162.45	1349	219.15	1464	104.83	1415
LEFT LAP LOADS (LB)						
X AXIS	66.72	1350	66.72	1469	35.58	1407
Y AXIS	21.96	1354	19.60	1485	8.40	1416
Z AXIS	62.71	1339	54.61	1482	12.09	1408
RESULTANT	92.61	1354	87.11	1480	39.75	1407
RIGHT LAP LOADS (LB)						
X AXIS	54.43	1333	55.71	1439	23.79	1407
Y AXIS	22.02	1341	22.02	1442	9.06	1407
Z AXIS	60.58	1350	41.80	1670	6.34	1406
RESULTANT	84.20	1350	68.72	1439	26.24	1407
TOTAL LAP LOAD (LB)	176.75	1350	150.35	1480	65.99	1407
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	0.32	511	14.94	1493	-51.49	1422
X AXIS (RIGHT)	7.06	510	9.99	1466	-18.67	1411
X AXIS (SUM)	6.21	511	12.65	1493	-59.79	1411
Y AXIS (CENTER)	52.58	539	49.40	1527	3.05	1405
SEAT LOADS (LB)						
Z AXIS (LEFT)	48.85	509	451.90	1429	30.39	1246
Z AXIS (RIGHT)	66.51	509	406.96	1423	39.39	1664
Z AXIS (CENTER)	234.51	1354	1262.10	1422	161.58	1840
Z AXIS (SUM)	321.83	1354	2059.74	1424	251.52	1246
SEAT Z SUM / WT	1.84	1354	11.77	1424	1.44	1246
RESULTANT SEAT LOAD (LB)	324.34	1354	2060.55	1424	255.30	1246

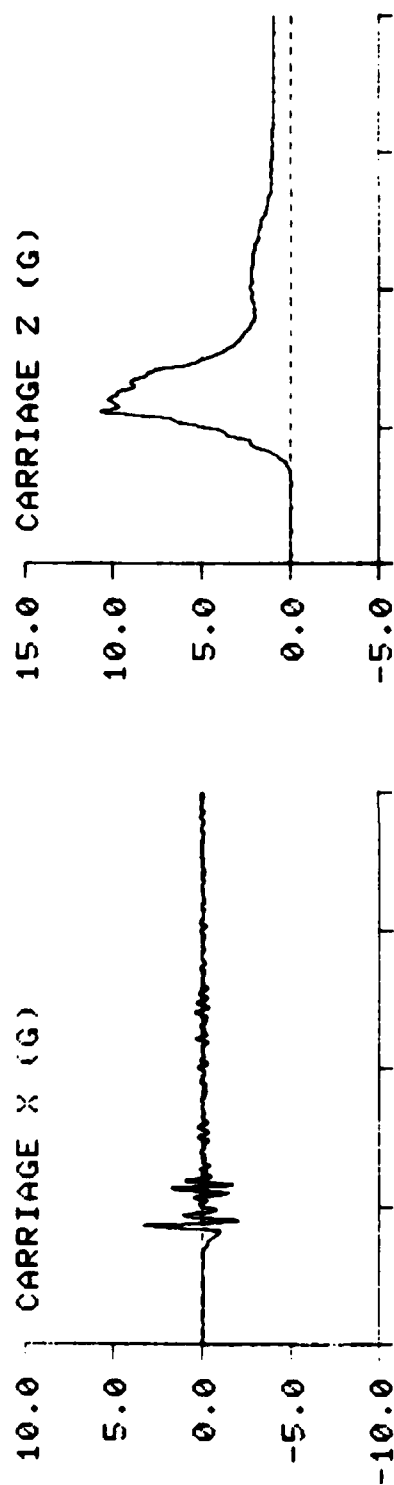
VERTICAL TEST PHASE	TEST: 651	SUBJ: W-4	WT: 194.0	CELL: H		
PARAMETER	FREEFALL MAXIMUM	TIME (MSEC)	IMPACT MAXIMUM	TIME (MSEC)	IMPACT MINIMUM	TIME (MSEC)
REFERENCE MARK				1254		
TIME OF IMPACT START				1366		
CARRIAGE ACCELERATION (G)						
X AXIS			2.17	1383	-1.76	1388
Y AXIS			0.28	1529	-0.69	1466
Z AXIS			10.54	1417	-0.11	1295
Z AXIS (SMOOTHED)			10.03	1429	-0.03	1316
CARRIAGE VELOCITY (FT/SEC)						
INTEGRATED ACCELERATION			0.01	1375	-26.28	1731
TACHOMETER (MEASURED)			-1.18	1734	-25.49	1366
SEAT ACCELERATION (G)						
X AXIS			1.98	1383	-1.66	1426
Y AXIS			1.40	1430	-0.78	1379
Z AXIS			11.74	1422	-0.26	1267
Z AXIS (SMOOTHED)			10.84	1419	-0.15	1265
CHEST ACCELERATION (G)						
X AXIS			2.70	1445	-1.88	1486
Y AXIS			0.85	1507	-4.24	1439
Z AXIS			16.07	1436	-1.02	1284
RESULTANT			16.49	1434	0.46	1376
CHEST SEVERITY INDEX			29.25			
HEAD ACCELERATION (G)						
X AXIS			4.24	1434	-1.18	1505
Y AXIS			1.03	1576	-0.76	1459
Z AXIS			10.70	1434	-0.77	1368
RESULTANT			11.51	1431	0.58	1380
HEAD SEVERITY INDEX			18.18			
NEGATIVE G STRAP	245.32	1363	207.03	1495	92.81	1422
SHOULDER STRAP LOADS (LB)						
X AXIS	97.78	1364	167.74	1488	43.81	1428
Y AXIS	4.15	782	1.24	1254		
Z AXIS	5.45	542	28.98	1470		
RESULTANT	97.84	1364	169.85	1488	48.82	1427
LEFT LAP LOADS (LB)						
X AXIS	87.70	1365	102.65	1442	67.77	1420
Y AXIS	29.76	1363	26.23	1447	20.33	1427
Z AXIS	86.12	1366	73.97	1475	40.56	1420
RESULTANT	126.47	1366	126.15	1442	81.86	1420
RIGHT LAP LOADS (LB)						
X AXIS	66.81	1365	83.41	1461	51.49	1412
Y AXIS	23.36	1359	29.19	1455	15.58	1419
Z AXIS	73.14	1364	71.05	1466	32.46	1419
RESULTANT	101.03	1365	111.35	1466	63.00	1420
TOTAL LAP LOAD (LB)	225.99	1365	232.37	1449	144.85	1420
SEAT LINK LOADS (LB)						
X AXIS (LEFT)	1.80	530	15.82	1508	-16.48	1442
X AXIS (RIGHT)	-2.25	558	3.02	1528	-42.01	1424
X AXIS (SUM)	-2.81	616	13.38	1536	-53.01	1424
Y AXIS (CENTER)	1.42	560	-2.39	1837	-27.79	1418
SEAT LOADS (LB)						
Z AXIS (LEFT)	85.41	1362	566.21	1463	40.43	1753
Z AXIS (RIGHT)	65.00	1366	594.04	1463	36.53	1783
Z AXIS (CENTER)	259.65	1366	1241.75	1435	148.01	1838
Z AXIS (SUM)	408.54	1366	2244.50	1436	242.39	1753
SEAT Z SUM / WT	2.11	1366	11.57	1436	1.25	1753
RESULTANT SEAT LOAD (LB)	409.12	1366	2245.18	1436	242.50	1753

# RESTRAINT CONFIGURATION STUDY

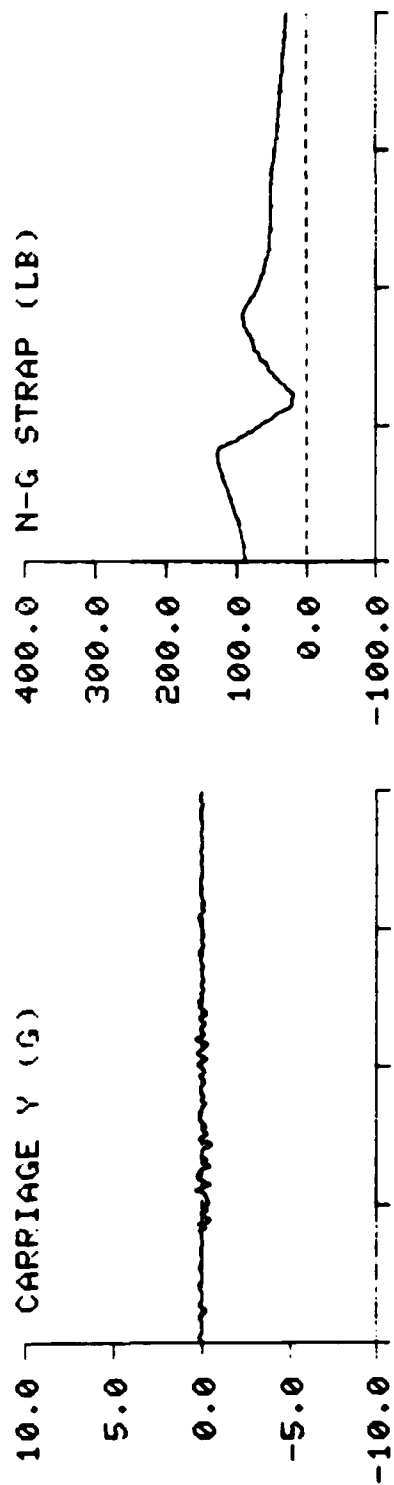
TEST NO: 715

SUBJ ID: R-2

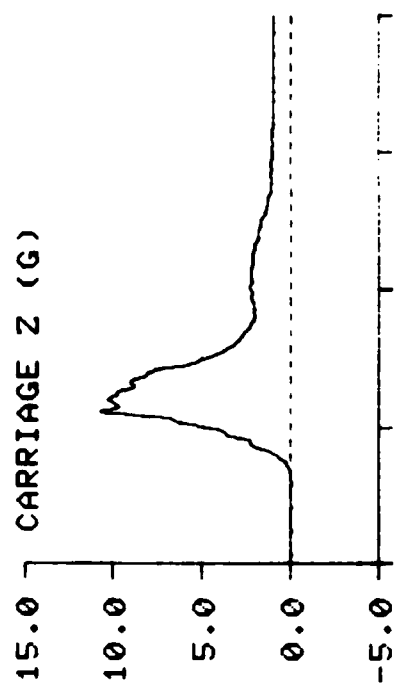
CARRIAGE X (G)



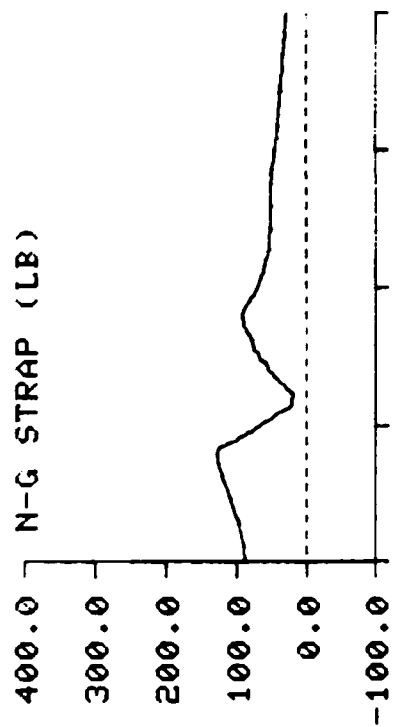
CARRIAGE Y (G)



CARRIAGE Z (G)

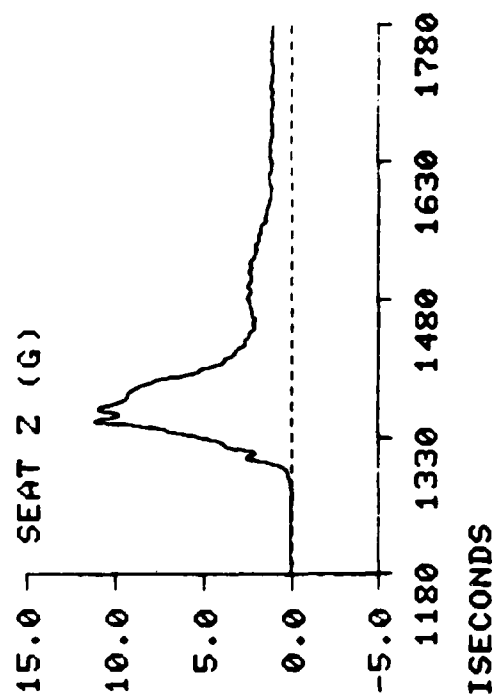
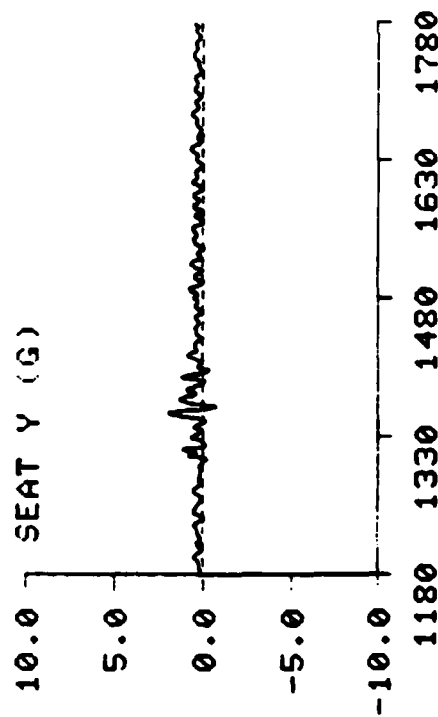
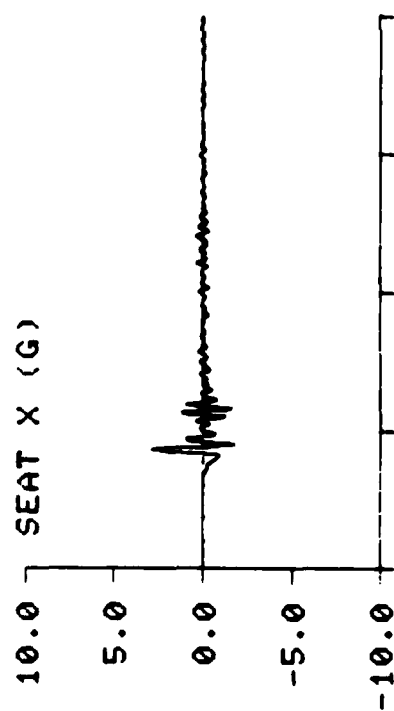


N-G STRAP (LB)



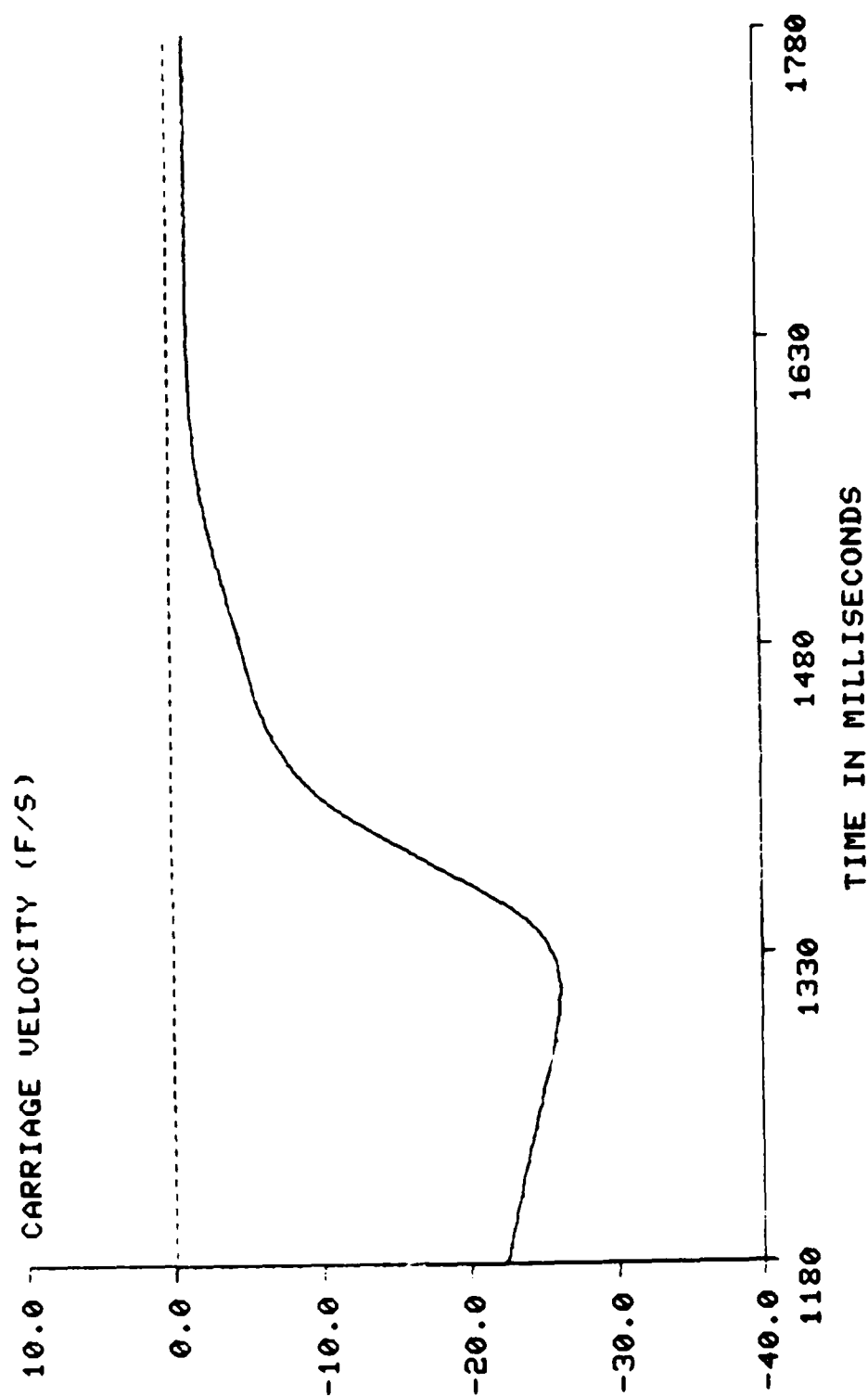
TIME IN MILLISECONDS

RESTRAINT CONFIGURATION STUDY      TEST NO: 715      SUBJ ID: R-2





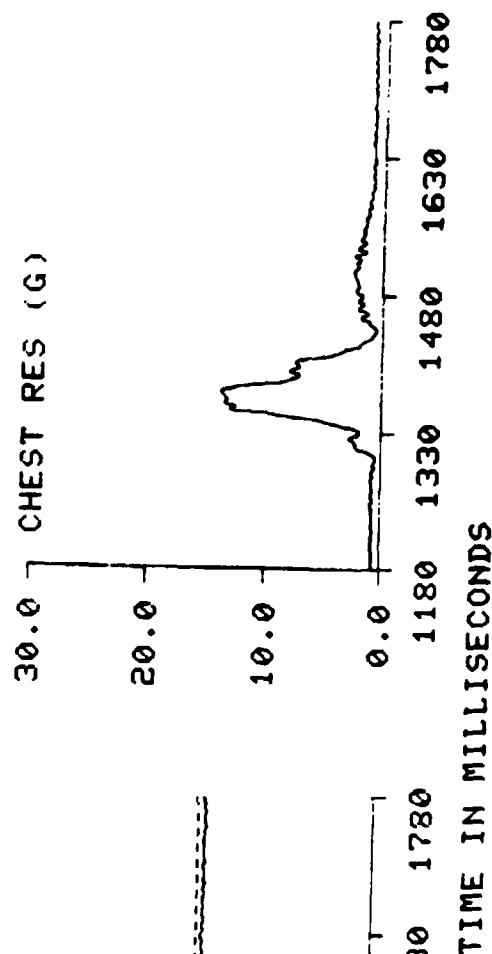
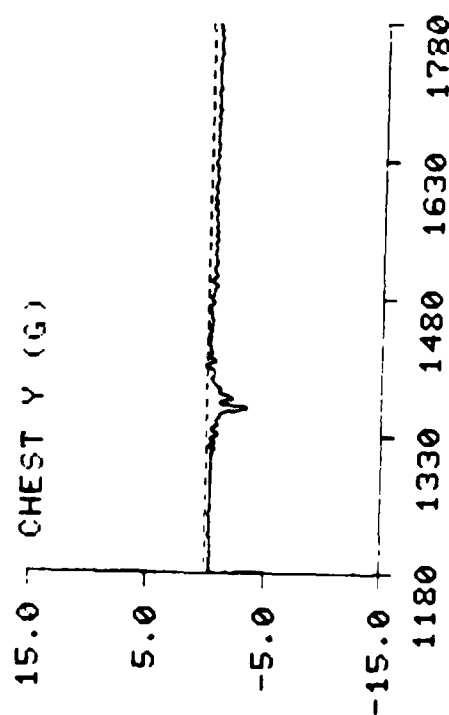
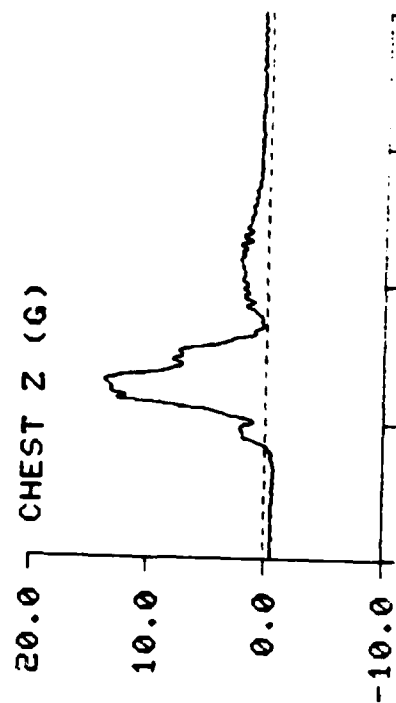
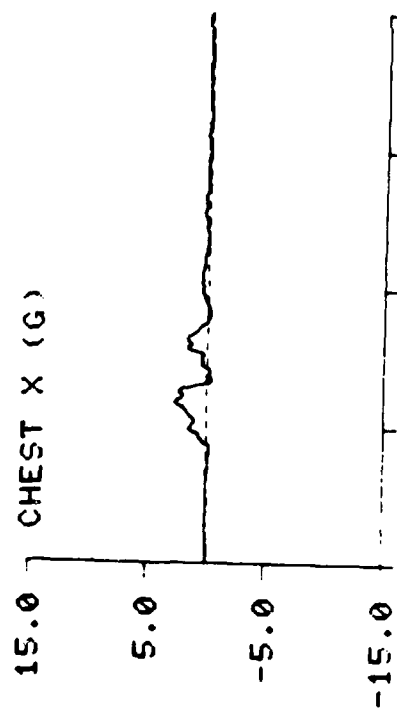
RESTRAINT CONFIGURATION STUDY      TEST NO: 715      SUBJ ID: R-2



RESTRAINT CONFIGURATION STUDY

TEST NO: 715

SUBJ ID: R-2



AD-A138 642

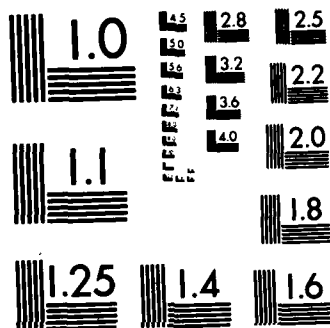
EFFECTS OF A NEGATIVE G STRAP ON RESTRAINT DYNAMICS AND  
HUMAN IMPACT RESPONSE(U) AIR FORCE AEROSPACE MEDICAL  
RESEARCH LAB WRIGHT-PATTERSON AFB. B F HEARON ET AL.  
DEC 83 AFAMRL-TR-83-083 F/G 6/17

4/4

UNCLASSIFIED

F/G 6/17

NL

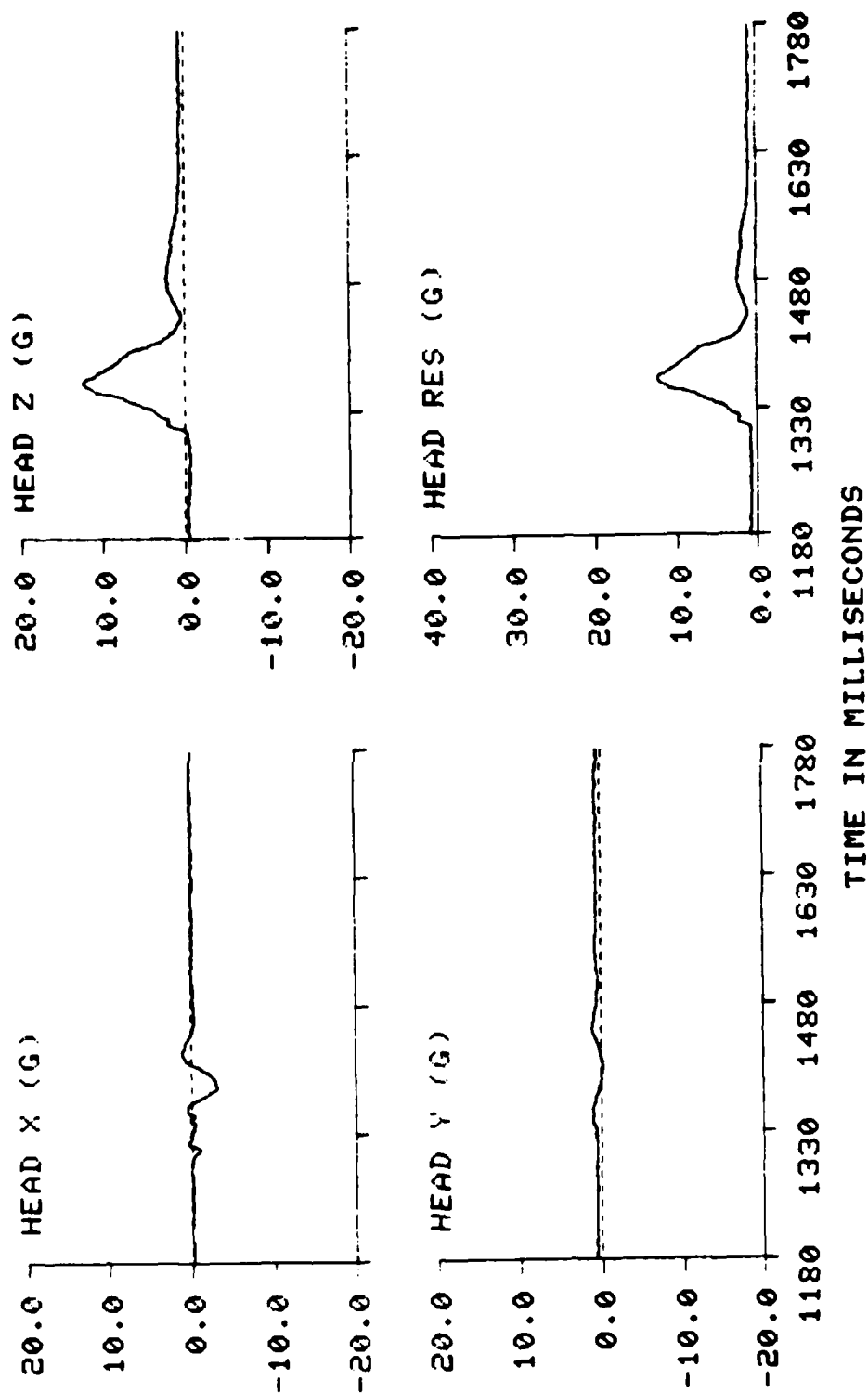


MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS 1963-A

# RESTRAINT CONFIGURATION STUDY

TEST NO: 715

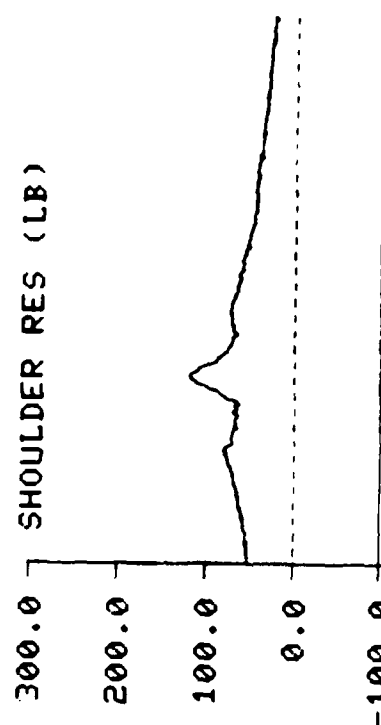
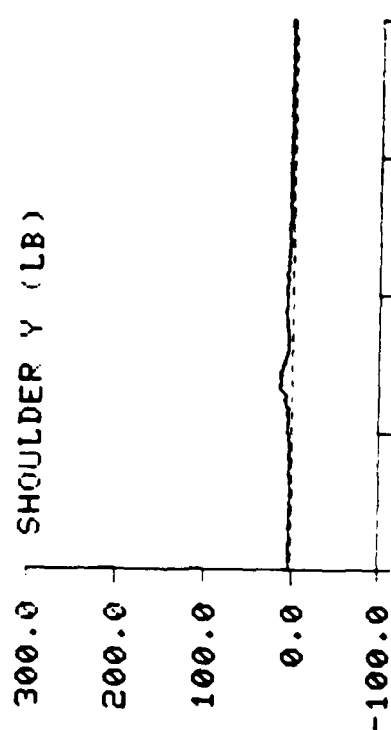
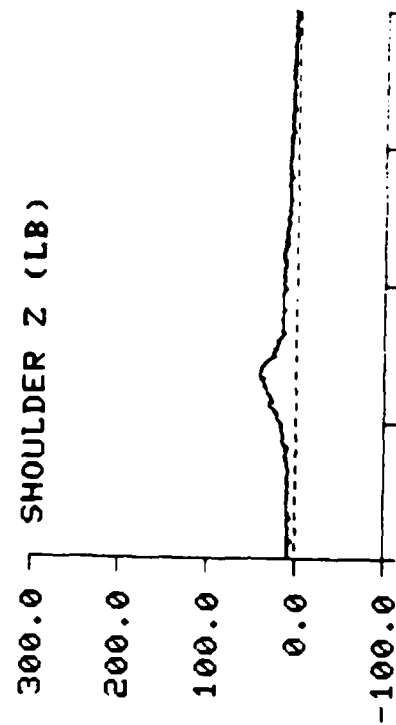
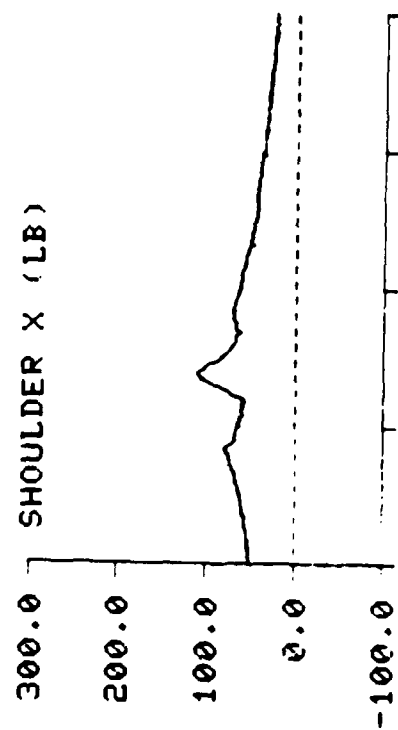
SUBJ ID: R-2



# RESTRAINT CONFIGURATION STUDY

TEST NO: 715

SUBJ ID: R-2



1180 1330 1480 1630 1780

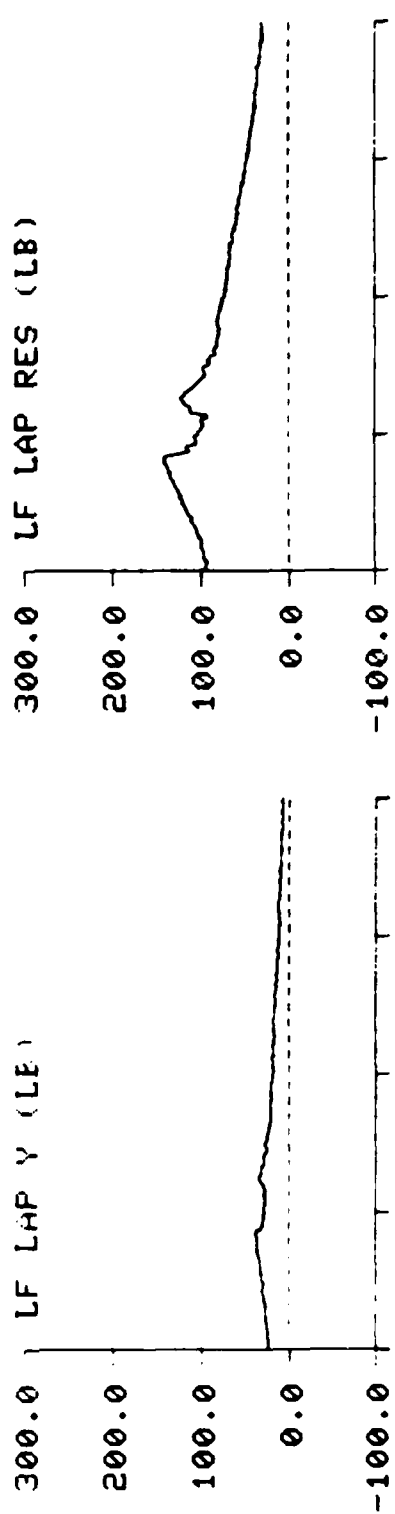
1180 1330 1480 1630 1780

TIME IN MILLISECONDS

# RESTRAINT CONFIGURATION STUDY

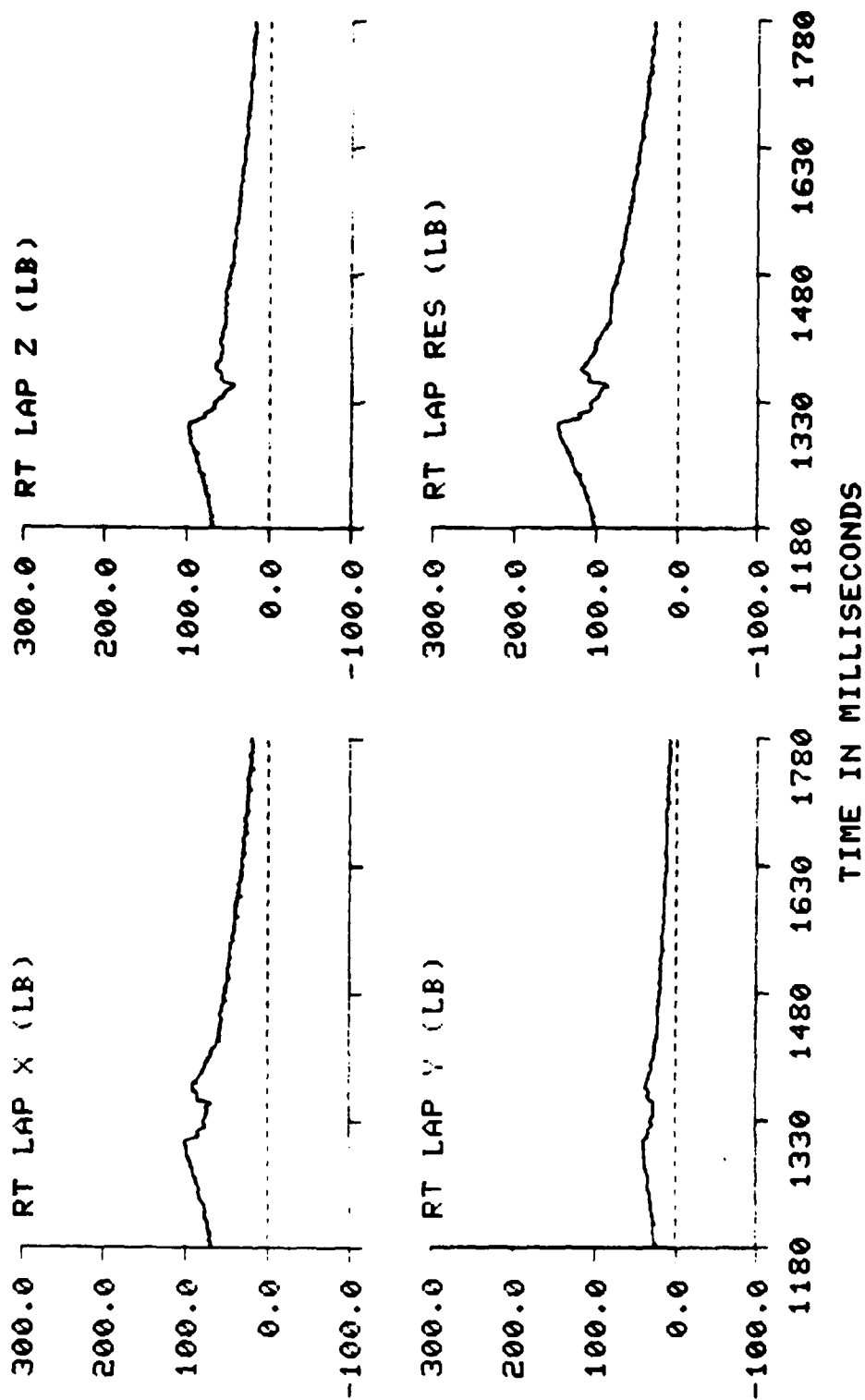
TEST NO: 715

SUBJ ID: R-2



TIME IN MILLISECONDS

RESTRAINT CONFIGURATION STUDY      TEST NO: 715      SUBJ ID: R-2

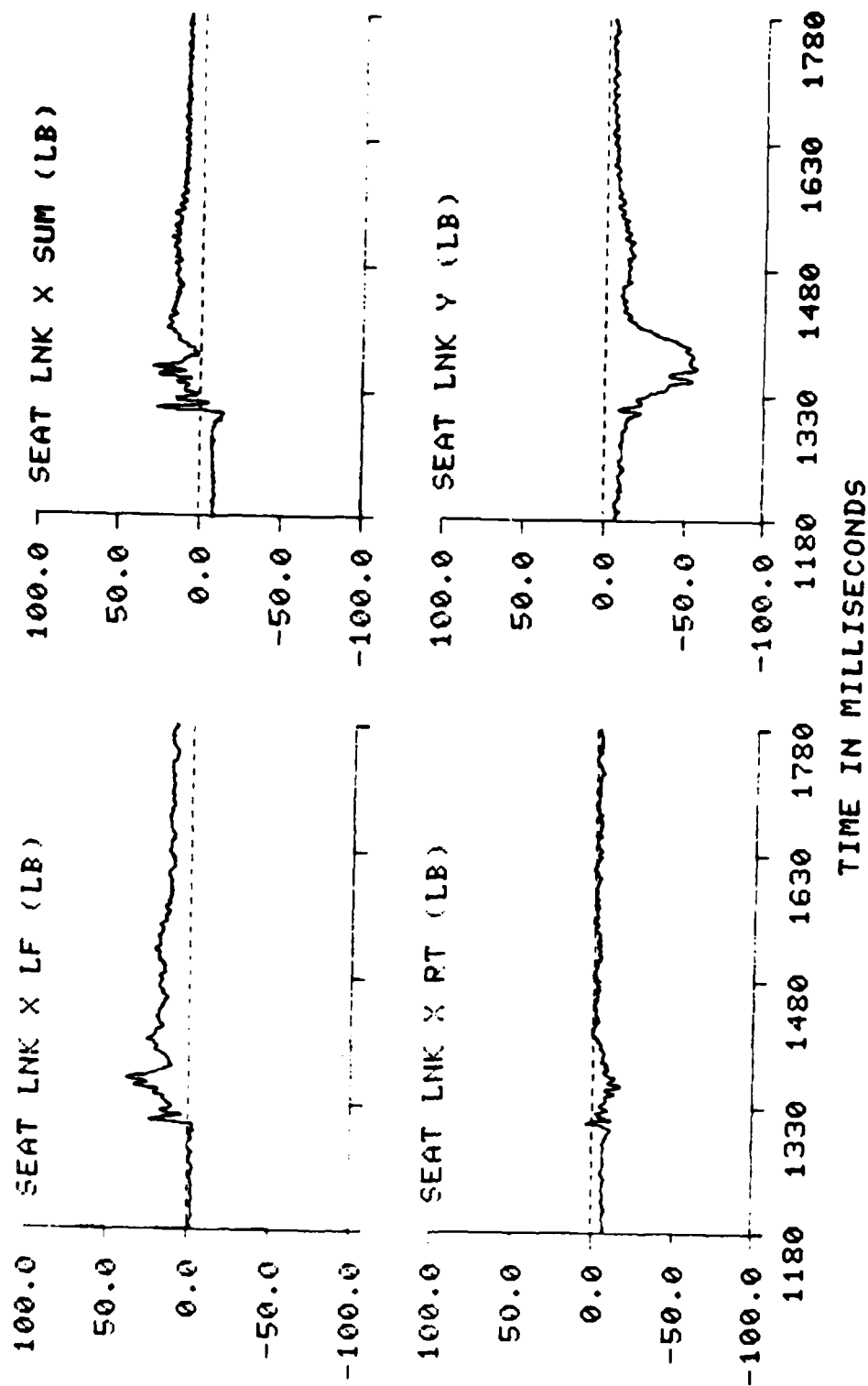




# RESTRAINT CONFIGURATION STUDY

TEST NO: 715

SUBJ ID: R-2



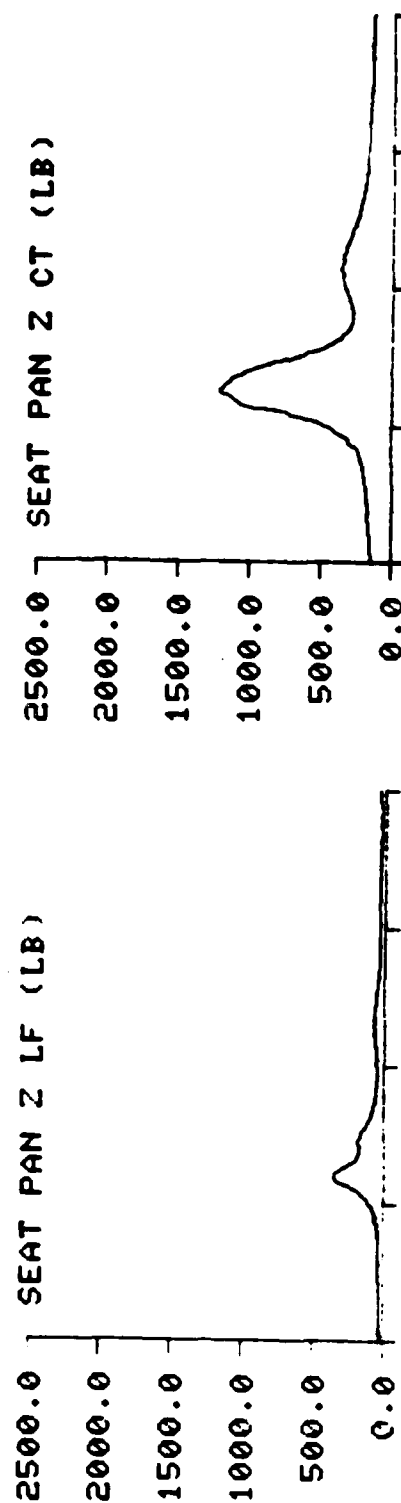
# RESTRAINT CONFIGURATION STUDY

TEST NO: 715

SUBJ ID: R-2

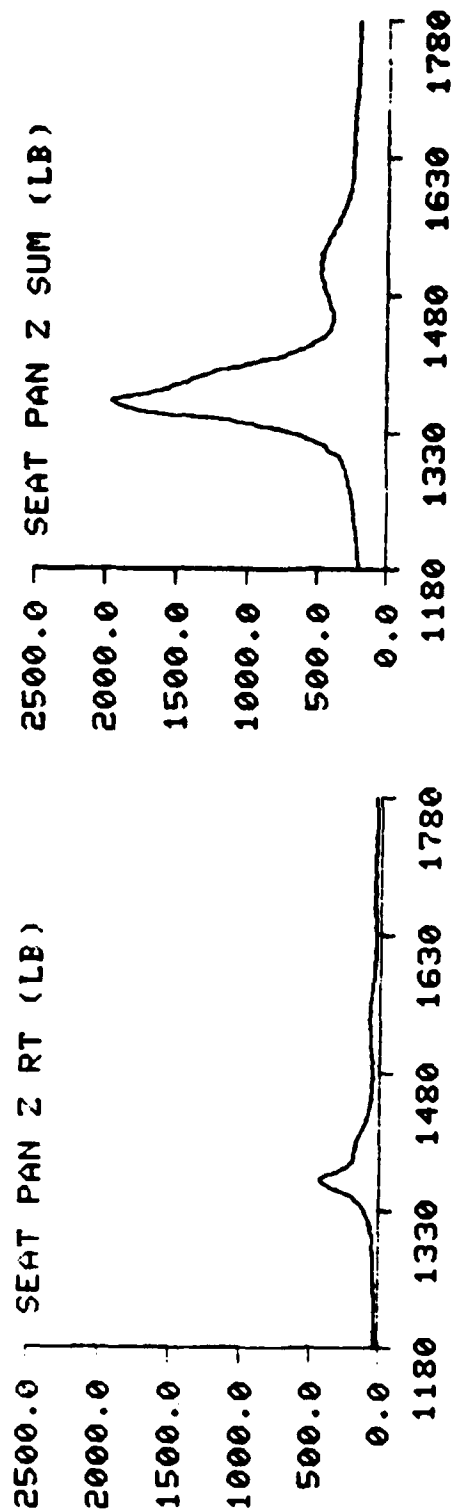
SEAT PAN Z LF (LB)

SEAT PAN Z CT (LB)



SEAT PAN Z RT (LB)

SEAT PAN Z SUM (LB)



TIME IN MILLISECONDS

## APPENDIX D

### ELECTRONIC DATA ANALYSIS

The electronic data from this test program were analyzed by means of the Wilcoxon paired-replicate rank test (Wilcoxon & Wilcox, 1964). A total of eight comparisons were made using this technique. The means and estimated standard deviations of each parameter in each comparison are summarized for the horizontal test phase in tables D-1 through D-4 and for the vertical test phase in tables D-5 through D-8. Acceleration means were first rounded to three significant digits. Load means less than or equal to 999.49 lb were rounded to the nearest pound; load means greater than 999.49 lb were rounded to three significant digits.

The number of comparable tests in one comparison may be different from the number of comparable tests in another comparison. Therefore, minor variations in the means and standard deviations in a given cell may be noted among these tables. An asterisk designates a statistically significant trend in a parameter at the 95% confidence level for a two-tailed test. The statistically significant trends in these parameters are summarized in terms of percentage and magnitude increases in parameters means in Tables 3, 5, 7, and 8. (See sections 3B and 3C.)

The Wilcoxon analyses of parameters for which there were statistically significant differences are also presented. Vehicle accelerations and velocities and subject accelerations and Severity Indices were all referenced to zero baseline, whereas all load data were referenced to measured pre-impact loads. (See sections 2C and 4C.)

In the Wilcoxon computations, the arithmetic difference between the parameter means is first computed. These differences are then rank ordered from smallest to largest, without regard to sign. Zero differences are ignored. Then, an integer from 1 to  $n$ , where  $n$  is the number of pairs in the comparison, is assigned to each difference so that the smallest difference receives the rank 1 and the largest difference receives the rank  $n$ . The rank integer is then given the same sign as the sign of the arithmetic difference to which it corresponds. The negative integers are summed and the positive integers are summed. Finally, these sums are compared to critical values for the specified confidence level. If the larger sum is greater than or equal to (or the smaller sum is less than or equal to) an appropriate critical value, then the means may be considered statistically different (i.e., from two different samples).

The advantages of employing this statistical technique are particularly noteworthy in these experiments. The technique is comparative and, therefore, is readily applied to the comparison of, for example, two different restraint configurations. Also, the method establishes each subject as his own control, thereby reducing the effects of biological variability on the data. In addition, a relatively small number of paired-replicates (6) is the minimum number required to permit a valid conclusion at the 95% confidence level.

The disadvantages of the Wilcoxon technique, however, must also be considered. Although the trend (direction) of a statistically significant difference in a given parameter is indicated, the magnitude of that difference is not quantified by the technique. (The difference between the means of the two sets of parameters being compared may be easily computed, however.) The method is also less sensitive than, for example, the analysis of variance. As in any statistical technique, statistical significance can be computed, but practical significance must be judged.

A complete set of Wilcoxon computations for all comparisons in this test program will be maintained in the Biomechanical Protection Branch until this work unit is retired. Eventually, these data will be recorded in a permanent biodynamics data bank within AFAMRL.

TABLE D-1

SUMMARY OF ELECTRONICALLY MEASURED AND COMPUTED DATA  
FROM WILCOXON COMPARISON A-B

(PEAK VALUES ARE TABULATED FOR VELOCITY, ACCELERATIONS AND LOADS.)

(N = 14)

TEST CONDITION RESTRAINT HARNESS NEGATIVE G STRAP	A PCU-15/P NO		B PCU-15/P YES		SIGNIFICANT AT 95% CONFIDENCE
	MEAN	ST DEV	MEAN	ST DEV	
SLED X ACCELERATION (G)	-9.50	0.09	-9.50	0.09	
SLED VELOCITY (FT/SEC)	-30.2	0.20	-30.1	0.21	
SEAT X ACCELERATION (G)	-9.92	0.13	-9.93	0.11	
CHEST ACCELERATION (G)					
-X AXIS	-20.3	4.65	-21.7	4.65	
+Z AXIS	15.3	3.43	16.6	4.69	
RESULTANT	24.6	4.51	25.5	5.15	
CHEST SEVERITY INDEX	65.1	13.6	70.0	19.4	
-EAD ACCELERATION (G)					
-X AXIS	-13.5	2.54	-13.3	3.34	
-Z AXIS	-12.0	4.38	-11.2	5.23	
RESULTANT	17.4	4.42	16.8	4.43	
-EAD SEVERITY INDEX	62.3	16.2	55.9	17.9	
STRAP LOAD (LB)					
TOTAL SHOULDER STRAPS	659	99	692	89	*
TOTAL LAP BELT	1930	277	2080	362	*
VERTICAL SEAT LOAD (LB)	1500	234	1530	289	

TABLE D-2

SUMMARY OF ELECTRONICALLY MEASURED AND COMPUTED DATA  
FROM WILCOXON COMPARISON C-D

(PEAK VALUES ARE TABULATED FOR VELOCITY, ACCELERATIONS AND LOADS.)

(N = 18)

TEST CONDITION RESTRAINT HARNESS NEGATIVE G STRAP	C CONVENTIONAL NO		D CONVENTIONAL YES		SIGNIFICANT AT 95% CONFIDENCE
	MEAN	ST DEV	MEAN	ST DEV	
SLED X ACCELERATION (G)	-9.47	0.08	-9.45	0.07	
SLED VELOCITY (FT/SEC)	-30.2	0.17	-30.2	0.15	
SEAT X ACCELERATION (G)	-9.90	0.11	-9.89	0.06	
CHEST ACCELERATION (G)					
-X AXIS	-13.0	1.13	-16.2	2.36	*
+Z AXIS	11.1	4.63	9.78	2.27	
RESULTANT	16.1	2.23	17.3	2.14	
CHEST SEVERITY INDEX	36.8	8.51	42.3	7.12	*
HEAD ACCELERATION (G)					
-X AXIS	-14.3	2.81	-14.4	3.75	
-Z AXIS	-9.26	4.05	-11.2	5.54	
RESULTANT	16.7	3.59	17.8	5.42	
HEAD SEVERITY INDEX	55.8	20.4	60.8	22.8	
STRAP LOAD (LB)					
TOTAL SHOULDER STRAPS	621	101	728	125	*
TOTAL LAP BELT	1690	205	1860	280	*
VERTICAL SEAT LOAD (LB)	1340	200	1530	303	*

TABLE D-3

SUMMARY OF ELECTRONICALLY MEASURED AND COMPUTED DATA  
FROM WILCOXON COMPARISON A-C

(PEAK VALUES ARE TABULATED FOR VELOCITY, ACCELERATIONS AND LOADS.)

(N = 15)

TEST CONDITION RESTRAINT HARNESS NEGATIVE G STRAP	A PCU-15/P NO		C CONVENTIONAL NO		SIGNIFICANT AT 95% CONFIDENCE
	MEAN	ST DEV	MEAN	ST DEV	
SLED X ACCELERATION (G)	-9.50	0.10	-9.45	0.08	
SLED VELOCITY (FT/SEC)	-30.2	0.19	-30.2	0.15	
SEAT X ACCELERATION (G)	-9.92	0.13	-9.88	0.11	
CHEST ACCELERATION (G)					
-X AXIS	-20.7	5.35	-12.9	1.21	*
+Z AXIS	15.4	4.04	11.7	4.90	*
RESULTANT	24.5	5.09	16.2	2.42	*
CHEST SEVERITY INDEX	66.1	17.9	37.7	8.90	*
HEAD ACCELERATION (G)					
-X AXIS	-13.4	2.56	-14.4	2.91	
+Z AXIS	-11.6	3.83	-9.17	4.31	*
RESULTANT	16.9	3.66	16.7	3.53	
HEAD SEVERITY INDEX	63.0	16.0	56.3	20.7	
STRAP LOAD (LB)					
TOTAL SHOULDER STRAPS	673	119	607	91	*
TOTAL LAP BELT	1920	284	1690	178	*
VERTICAL SEAT LOAD (LB)	1480	238	1340	197	*

TABLE D-4

SUMMARY OF ELECTRONICALLY MEASURED AND COMPUTED DATA  
FROM WILCOXON COMPARISON B-D

(PEAK VALUES ARE TABULATED FOR VELOCITY, ACCELERATIONS AND LOADS.)

(N = 14)

TEST CONDITION	B PCU-15/P		D CONVENTIONAL		SIGNIFICANT
RESTRAINT HARNESS	YES		YES		AT 95%
NEGATIVE G STRAP					CONFIDENCE
	MEAN	ST DEV	MEAN	ST DEV	
SLED X ACCELERATION (G)	-9.50	0.09	-9.46	0.06	
SLED VELOCITY (FT/SEC)	-30.1	0.22	-30.2	0.12	
SEAT X ACCELERATION (G)	-9.93	0.11	-9.90	0.06	
CHEST ACCELERATION (G)					
-X AXIS	-22.5	4.94	-16.2	2.34	*
+Z AXIS	16.4	4.88	9.89	2.44	*
RESULTANT	26.2	5.12	17.3	2.04	*
CHEST SEVERITY INDEX	72.3	19.3	43.2	7.25	*
HEAD ACCELERATION (G)					
-X AXIS	-13.1	3.31	-14.7	3.94	
+Z AXIS	-10.6	4.91	-11.3	5.97	
RESULTANT	16.3	4.11	18.2	5.57	
HEAD SEVERITY INDEX	54.6	17.8	63.2	22.4	
STRAP LOAD (LB)					
TOTAL SHOULDER STRAPS	702	95	706	59	
TOTAL LAP BELT	2090	358	1870	291	*
NEGATIVE G STRAP	136	52	212	81	*
VERTICAL SEAT LOAD (LB)	1530	289	1510	303	



TABLE D-5

SUMMARY OF ELECTRONICALLY MEASURED AND COMPUTED DATA  
FROM WILCOXON COMPARISON E-F

(PEAK VALUES ARE TABULATED FOR VELOCITY, ACCELERATIONS AND LOADS.)

(N = 16)

TEST CONDITION RESTRAINT HARNESS NEGATIVE G STRAP	E PCU-15/P NO		F PCU-15/P YES		SIGNIFICANT AT 95% CONFIDENCE
	MEAN	ST DEV	MEAN	ST DEV	
CARRIAGE Z ACCELERATION (G)	9.93	0.05	9.93	0.06	
CARRIAGE VELOCITY (FT/SEC)	-26.2	0.11	-26.3	0.14	
SEAT Z ACCELERATION (G)	10.9	0.15	10.9	0.21	*
CHEST ACCELERATION (G)					
-X AXIS	-1.10	0.75	-0.99	0.60	
+X AXIS	2.51	1.55	2.46	1.39	
+Z AXIS	19.5	2.20	19.0	2.24	
RESULTANT	19.8	2.11	19.3	2.20	
CHEST SEVERITY INDEX	37.3	4.48	36.0	4.25	
HEAD ACCELERATION (G)					
-X AXIS	-1.18	0.94	-1.29	0.89	
+X AXIS	3.29	1.49	3.00	1.65	
+Z AXIS	12.8	1.37	12.6	0.89	
RESULTANT	13.3	1.24	13.0	0.82	
HEAD SEVERITY INDEX	23.3	1.98	22.2	1.85	*
FREE FALL STRAP LOADS (LB)					
TOTAL SHOULDER STRAP	66	23	70	23	
TOTAL LAP BELT	264	66	240	61	*
IMPACT STRAP LOADS (LB)					
TOTAL SHOULDER STRAPS	108	30	104	29	
TOTAL LAP BELTS	110	41	88	27	*
FREE FALL SEAT LOADS (LB)					
+Z AXIS	243	49	276	70	*
RESULTANT	246	50	279	69	*
IMPACT SEAT LOADS (LB)					
-X AXIS	13	16	8	25	
+Z AXIS	2040	238	1980	246	*
RESULTANT	2040	238	1980	247	*

TABLE D-6

SUMMARY OF ELECTRONICALLY MEASURED AND COMPUTED DATA  
FROM WILCOXON COMPARISON G-H

(PEAK VALUES ARE TABULATED FOR VELOCITY, ACCELERATIONS AND LOADS.)

(N = 15)

TEST CONDITION RESTRAINT HARNESS NEGATIVE G STRAP	G CONVENTIONAL NO		H CONVENTIONAL YES		SIGNIFICANT AT 95% CONFIDENCE
	MEAN	ST DEV	MEAN	ST DEV	
CARRIAGE Z ACCELERATION (G)	9.97	0.05	10.0	0.05	*
CARRIAGE VELOCITY (FT/SEC)	-26.2	0.12	-26.2	0.26	
SEAT Z ACCELERATION (G)	10.9	0.18	11.0	0.15	
CHEST ACCELERATION (G)					
-X AXIS	-0.71	0.50	-0.78	0.60	
+X AXIS	2.67	1.03	2.66	0.94	
+Z AXIS	16.3	1.89	14.9	1.05	*
RESULTANT	16.5	1.85	15.2	1.04	*
CHEST SEVERITY INDEX	30.1	1.99	27.3	2.08	*
HEAD ACCELERATION (G)					
-X AXIS	-1.36	0.96	-1.73	1.06	
+X AXIS	3.06	1.34	2.85	1.03	
+Z AXIS	12.3	0.89	11.6	1.03	*
RESULTANT	12.8	0.88	12.0	0.90	*
HEAD SEVERITY INDEX	23.0	3.46	20.2	1.75	*
FREE FALL STRAP LOADS (LB)					
TOTAL SHOULDER STRAP	93	31	134	45	*
TOTAL LAP BELT	315	95	270	62	
IMPACT STRAP LOADS (LB)					
TOTAL SHOULDER STRAPS	74	37	38	46	*
TOTAL LAP BELTS	126	40	85	24	*
FREE FALL SEAT LOADS (LB)					
+Z AXIS	270	82	407	107	*
RESULTANT	272	82	408	107	
IMPACT SEAT LOADS (LB)					
-X AXIS	-60	24	-58	21	
+Z AXIS	1890	222	1780	236	*
RESULTANT	1890	222	1780	237	*

TABLE D-7

SUMMARY OF ELECTRONICALLY MEASURED AND COMPUTED DATA  
FROM WILCOXON COMPARISON E-G

(PEAK VALUES ARE TABULATED FOR VELOCITY, ACCELERATIONS AND LOADS.)

(N = 14)

TEST CONDITION RESTRAINT HARNESS NEGATIVE G STRAP	E PCU-15/P NO		G CONVENTIONAL NO		SIGNIFICANT AT 95% CONFIDENCE
	MEAN	ST DEV	MEAN	ST DEV	
CARRIAGE Z ACCELERATION (G)	9.92	0.05	9.96	0.05	x
CARRIAGE VELOCITY (FT/SEC)	-26.2	0.12	-26.2	0.12	
SEAT Z ACCELERATION (G)	10.9	0.16	10.8	0.16	
CHEST ACCELERATION (G)					
-X AXIS	-1.13	0.79	-0.71	0.52	
+X AXIS	2.55	1.59	2.68	1.07	
+Z AXIS	19.7	2.24	16.3	1.94	x
RESULTANT	19.9	2.13	16.6	1.89	x
CHEST SEVERITY INDEX	37.6	4.47	30.1	2.06	x
HEAD ACCELERATION (G)					
-X AXIS	-1.14	0.89	-1.41	0.98	
+X AXIS	3.34	1.45	3.08	1.39	
+Z AXIS	12.8	1.42	12.4	0.92	
RESULTANT	13.3	1.30	12.8	0.90	
HEAD SEVERITY INDEX	23.4	2.10	23.2	3.52	
FREE FALL STRAP LOADS (LB)					
TOTAL SHOULDER STRAP	64	21	92	31	x
TOTAL LAP BELT	256	65	318	97	x
IMPACT STRAP LOADS (LB)					
TOTAL SHOULDER STRAPS	106	31	69	33	x
TOTAL LAP BELTS	116	40	124	41	
FREE FALL SEAT LOADS (LB)					
+Z AXIS	240	51	274	83	x
RESULTANT	243	53	275	83	x
IMPACT SEAT LOADS (LB)					
-X AXIS	12	17	9	19	x
+Z AXIS	2050	250	1890	230	x
RESULTANT	2050	250	1890	230	x

TABLE D-8

SUMMARY OF ELECTRONICALLY MEASURED AND COMPUTED DATA  
FROM WILCOXON COMPARISON F-H

(PEAK VALUES ARE TABULATED FOR VELOCITY, ACCELERATIONS AND LOADS.)

(N = 16)

TEST CONDITION RESTRAINT HARNESS NEGATIVE G STRAP	F PCU-15/P YES		H CONVENTIONAL YES		SIGNIFICANT AT 95% CONFIDENCE
	MEAN	ST DEV	MEAN	ST DEV	
CARRIAGE Z ACCELERATION (G)	9.94	0.07	10.0	0.05	*
CARRIAGE VELOCITY (FT/SEC)	-26.3	0.13	-26.2	0.25	*
SEAT Z ACCELERATION (G)	10.9	0.20	11.0	0.15	
CHEST ACCELERATION (G)					
-X AXIS	-0.95	0.56	-0.74	0.60	
+X AXIS	2.54	1.38	2.68	0.91	
+Z AXIS	18.8	2.55	15.1	1.19	*
RESULTANT	19.1	2.51	15.3	1.20	*
CHEST SEVERITY INDEX	35.5	4.84	27.3	2.01	*
HEAD ACCELERATION (G)					
-X AXIS	-1.31	0.87	-1.78	1.04	
+X AXIS	2.83	1.52	2.72	1.12	
+Z AXIS	12.5	0.95	11.7	1.05	*
RESULTANT	12.9	0.87	12.1	0.90	*
HEAD SEVERITY INDEX	21.9	1.95	20.2	1.70	*
FREE FALL STRAP LOADS (LB)					
TOTAL SHOULDER STRAP	76	31	131	46	*
TOTAL LAP BELT	244	67	277	66	*
NEGATIVE G STRAP	80	33	223	67	*
IMPACT STRAP LOADS (LB)					
TOTAL SHOULDER STRAPS	106	32	40	45	*
TOTAL LAP BELTS	93	27	82	25	
NEGATIVE G STRAP	80	33	101	26	*
FREE FALL SEAT LOADS (LB)					
+Z AXIS	279	72	410	104	*
RESULTANT	282	71	411	104	*
IMPACT SEAT LOADS (LB)					
-X AXIS	9	26	-57	20	*
+Z AXIS	1960	264	1760	233	*
RESULTANT	1960	264	1760	234	*

# WILCOXON COMPARISON A-B

ANALYSIS OF TOTAL SHOULDER STRAP LOAD (LB)  
(IMPACT MAXIMUM MINUS IMMEDIATE PREIMPACT)

## DATA

CONDITION A			CONDITION B		
SUBJ	IMMEDIATE PREIMPACT	IMPACT MAXIMUM	SUBJ	IMMEDIATE PREIMPACT	IMPACT MAXIMUM
A-2	33.54	772.71	A-2	25.61	778.69
B-3	21.76	688.17	B-3	33.53	689.44
P-3	63.05	795.02	P-3	30.79	771.88
C-2	31.11	832.41	C-2	13.66	852.03
J-3	49.59	537.20	J-3	73.54	582.37
B-2	63.13	753.02	B-2	41.23	796.43
J-4	66.09	570.72	J-4	41.61	625.42
G-3	36.59	700.31	G-3	36.15	753.29
A-3	41.49	757.25	A-3	65.90	788.79
B-1	24.99	595.02	B-1	29.16	611.43
C-1	20.86	717.80	C-1	34.58	703.59
M-4	39.88	734.85	M-4	46.13	733.49
K-1	41.31	788.76	K-1	50.40	849.25
F-2	59.48	579.89	F-2	36.29	708.78

## ANALYSIS

SUBJ	A CELL VALUE	B CELL VALUE	DIFFERENCE (A - B)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
A-2	739.17	753.08	-13.91	6.00	6.00	0.00
B-3	666.41	655.91	10.50	4.00	0.00	4.00
P-3	731.97	741.09	-9.12	3.00	3.00	0.00
C-2	801.30	838.37	-37.07	9.00	9.00	0.00
J-3	487.61	508.83	-21.22	7.00	7.00	0.00
B-2	689.89	755.20	-65.31	12.00	12.00	0.00
J-4	504.63	583.81	-79.18	13.00	13.00	0.00
G-3	663.72	717.14	-53.42	11.00	11.00	0.00
A-3	715.76	722.89	-7.13	1.00	1.00	0.00
B-1	570.03	582.27	-12.24	5.00	5.00	0.00
C-1	696.94	669.01	27.93	8.00	0.00	8.00
M-4	694.97	687.36	7.61	2.00	0.00	2.00
K-1	747.45	798.85	-51.40	10.00	10.00	0.00
F-2	520.41	672.49	-152.08	14.00	14.00	0.00

MEAN A: 659.30 STD DEV A: 98.89 SUM OF NEG RANKS: 91.00  
MEAN B: 691.88 STD DEV B: 89.48 SUM OF POS RANKS: 14.00

THERE IS A 5% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.02$ ).

# WILCOXON COMPARISON A-B

## ANALYSIS OF TOTAL LAP BELT LOAD (LB)

(IMPACT MAXIMUM MINUS IMMEDIATE PREIMPACT)

### DATA

CONDITION A			CONDITION B		
SUBJ	IMMEDIATE PREIMPACT	IMPACT MAXIMUM	SUBJ	IMMEDIATE PREIMPACT	IMPACT MAXIMUM
R-2	50.19	1596.89	R-2	35.97	1684.77
B-3	191.94	2163.14	B-3	144.73	2095.40
P-3	118.26	2047.72	P-3	78.63	2249.54
C-2	59.79	2364.02	C-2	28.85	2675.66
J-3	222.45	1666.16	J-3	156.55	1775.16
B-2	83.81	1967.23	B-2	58.31	2690.17
J-4	194.52	2271.52	J-4	149.98	2433.91
G-3	82.52	2081.55	G-3	49.26	2303.92
A-3	64.76	2033.21	A-3	104.79	1964.63
B-1	89.63	1708.65	B-1	99.06	1668.50
C-1	109.44	2117.87	C-1	116.71	2020.19
M-4	76.09	2564.78	M-4	88.88	2642.44
K-1	122.38	2099.22	K-1	121.22	2195.75
F-2	141.26	1923.34	F-2	81.39	2046.09

### ANALYSIS

SUBJ	A CELL VALUE	B CELL VALUE	DIFFERENCE (A - B)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
R-2	1546.70	1648.80	-102.10	5.00	5.00	0.00
B-3	1971.20	1950.67	20.53	1.00	0.00	1.00
P-3	1929.46	2170.91	-241.45	11.00	11.00	0.00
C-2	2304.23	2646.81	-342.58	13.00	13.00	0.00
J-3	1443.71	1618.61	-174.90	8.00	8.00	0.00
B-2	1883.42	2631.86	-748.44	14.00	14.00	0.00
J-4	2077.00	2283.93	-206.93	10.00	10.00	0.00
G-3	1999.03	2254.66	-255.63	12.00	12.00	0.00
A-3	1968.45	1859.84	108.61	7.00	0.00	7.00
B-1	1619.02	1569.44	49.58	2.00	0.00	2.00
C-1	2008.43	1903.48	104.95	6.00	0.00	6.00
M-4	2488.69	2553.56	-64.87	3.00	3.00	0.00
K-1	1976.84	2074.53	-97.69	4.00	4.00	0.00
F-2	1782.08	1964.70	-182.62	9.00	9.00	0.00

MEAN A: 1928.45    STD DEV A: 276.54    SUM OF NEG RANKS: 89.00    -----  
 MEAN B: 2080.84    STD DEV B: 361.58    SUM OF POS RANKS: -----    16.00

THERE IS A 8% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.05$ ).

# WILCOXON COMPARISON C-D

ANALYSIS OF CHEST X ACCELERATION (G)

(IMPACT MINIMUM)

SUBJ	C CELL VALUE	D CELL VALUE	DIFFERENCE (C - D)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
T-1	-12.37	-14.78	2.41	6.00	0.00	6.00
A-2	-14.00	-19.45	5.45	17.00	0.00	17.00
J-4	-12.39	-16.54	4.15	11.50	0.00	11.50
G-3	-10.03	-15.45	5.42	16.00	0.00	16.00
B-2	-12.57	-14.08	1.51	4.00	0.00	4.00
E-2	-13.75	-17.19	3.44	9.00	0.00	9.00
K-1	-13.91	-14.35	0.44	1.00	0.00	1.00
W-4	-14.31	-18.58	4.27	13.00	0.00	13.00
B-4	-13.66	-17.32	3.66	10.00	0.00	10.00
A-3	-12.57	-13.62	1.05	3.00	0.00	3.00
B-3	-10.88	-12.49	1.61	5.00	0.00	5.00
H-6	-13.53	-18.57	5.04	14.00	0.00	14.00
C-2	-13.83	-19.47	5.64	18.00	0.00	18.00
B-1	-14.22	-19.56	5.34	15.00	0.00	15.00
M13	-13.13	-12.26	-0.87	2.00	2.00	0.00
J-3	-12.44	-15.60	3.16	8.00	0.00	8.00
F-2	-12.67	-15.55	2.88	7.00	0.00	7.00
P-3	-13.11	-17.26	4.15	11.50	0.00	11.50

MEAN C: -12.97 STD DEV C: 1.13 SUM OF NEG RANKS: 2.00  
 MEAN D: -16.23 STD DEV D: 2.36 SUM OF POS RANKS: 169.00

THERE IS A 25% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON C-D

## ANALYSIS OF CHEST SEVERITY INDEX

(IMPACT MAXIMUM)

SUBJ	C CELL VALUE	D CELL VALUE	DIFFERENCE (C - D)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
T-1	27.54	34.36	-6.82	9.00	9.00	0.00
A-2	38.15	46.90	-8.75	10.00	10.00	0.00
J-4	29.38	38.51	-9.13	11.00	11.00	0.00
G-3	33.56	47.35	-13.79	16.00	16.00	0.00
B-2	36.55	38.16	-1.61	2.00	2.00	0.00
E-2	38.16	42.02	-3.86	6.00	6.00	0.00
K-1	36.48	47.53	-11.05	13.00	13.00	0.00
W-4	41.65	51.22	-9.57	12.00	12.00	0.00
B-4	32.05	37.90	-5.85	8.00	8.00	0.00
A-3	29.07	32.56	-3.49	5.00	5.00	0.00
B-3	32.19	35.23	-3.04	4.00	4.00	0.00
H-6	30.55	45.42	-14.87	17.00	17.00	0.00
C-2	49.58	48.73	0.85	1.00	0.00	1.00
B-1	36.21	52.36	-16.15	18.00	18.00	0.00
M13	33.16	30.57	2.59	3.00	0.00	3.00
J-3	29.32	41.25	-11.93	14.00	14.00	0.00
F-2	49.85	37.23	12.62	15.00	0.00	15.00
P-3	59.31	53.86	5.45	7.00	0.00	7.00

MEAN C: 36.82 STD DEV C: 8.51 SUM OF NEG RANKS: 145.00  
 MEAN D: 42.29 STD DEV D: 7.12 SUM OF POS RANKS: -----

26.00

THERE IS A 15% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).



# WILCOXON COMPARISON C-D

## ANALYSIS OF TOTAL SHOULDER STRAP LOAD (LB)

(IMPACT MAXIMUM MINUS IMMEDIATE PREIMPACT)

### DATA

CONDITION C			CONDITION D		
SUBJ	IMMEDIATE PREIMPACT	IMPACT MAXIMUM	SUBJ	IMMEDIATE PREIMPACT	IMPACT MAXIMUM
T-1	85.49	671.05	T-1	80.55	808.34
A-2	21.37	708.27	A-2	22.66	713.84
J-4	95.67	649.16	J-4	79.28	701.35
G-3	48.32	663.56	G-3	42.96	687.60
B-2	35.01	731.43	B-2	47.22	831.99
E-2	38.08	677.94	E-2	50.19	837.17
K-1	37.26	619.20	K-1	28.07	914.00
W-4	58.35	680.73	W-4	13.40	807.34
B-4	34.53	886.61	B-4	0.20	920.25
A-3	74.36	632.13	A-3	75.30	741.02
B-3	64.76	578.16	B-3	63.55	636.51
H-6	38.96	799.67	H-6	26.24	991.26
C-2	21.53	723.09	C-2	21.40	808.09
B-1	35.10	558.58	B-1	33.86	710.89
M13	24.04	567.19	M13	102.14	639.73
J-3	59.02	533.56	J-3	40.99	655.89
F-2	52.60	578.71	F-2	59.98	639.58
P-3	32.78	774.88	P-3	40.03	879.64

### ANALYSIS

SUBJ	C CELL VALUE	D CELL VALUE	DIFFERENCE (C - D)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
T-1	585.56	727.79	-142.23	13.00	13.00	0.00
A-2	686.90	691.18	-4.28	1.00	1.00	0.00
J-4	553.49	622.07	-68.58	7.00	7.00	0.00
G-3	615.24	644.64	-29.40	3.00	3.00	0.00
B-2	696.42	784.77	-88.35	9.00	9.00	0.00
E-2	639.86	786.98	-147.12	14.00	14.00	0.00
K-1	581.94	885.93	-303.99	18.00	18.00	0.00
W-4	622.38	793.94	-171.56	16.00	16.00	0.00
B-4	852.08	920.05	-67.97	6.00	6.00	0.00
A-3	557.77	665.72	-107.95	11.00	11.00	0.00
B-3	513.40	572.96	-59.56	5.00	5.00	0.00
H-6	760.71	965.02	-204.31	17.00	17.00	0.00
C-2	701.56	786.69	-85.13	8.00	8.00	0.00
B-1	523.48	677.03	-153.55	15.00	15.00	0.00
M13	543.15	537.59	5.56	2.00	0.00	2.00
J-3	474.54	614.90	-140.36	12.00	12.00	0.00
F-2	526.11	579.60	-53.49	4.00	4.00	0.00
P-3	742.10	839.61	-97.51	10.00	10.00	0.00

MEAN C: 620.93    STD DEV C: 101.01    SUM OF NEG RANKS: 169.00  
 MEAN D: 727.58    STD DEV D: 125.10    SUM OF POS RANKS: -----

-----  
2.00

THERE IS A 17% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON C-D

ANALYSIS OF TOTAL LAP BELT LOAD (LB)

(IMPACT MAXIMUM MINUS IMMEDIATE PREIMPACT)

DATA

CONDITION C			CONDITION D		
SUBJ	IMMEDIATE PREIMPACT	IMPACT MAXIMUM	SUBJ	IMMEDIATE PREIMPACT	IMPACT MAXIMUM
T-1	249.39	1523.93	T-1	113.58	1712.90
A-2	48.59	1622.64	A-2	41.59	1727.88
J-4	244.60	1955.57	J-4	173.35	2260.23
G-3	115.91	1674.31	G-3	57.41	2100.86
B-2	88.62	1749.18	B-2	80.09	1741.26
E-2	103.49	2044.97	E-2	86.37	2026.47
K-1	183.72	2010.21	K-1	62.05	2010.74
W-4	131.22	2108.26	W-4	25.46	2427.49
B-4	103.59	1982.29	B-4	0.63	1946.58
A-3	193.53	1600.37	A-3	131.57	1542.97
B-3	263.19	1929.19	B-3	174.73	1914.29
H-6	101.28	1921.39	H-6	50.52	2032.48
C-2	40.88	2010.59	C-2	33.31	2222.09
B-1	99.83	1637.36	B-1	54.75	1781.42
M13	103.57	1697.38	M13	198.83	1609.33
J-3	170.63	1833.51	J-3	94.19	1913.49
F-2	136.94	1629.38	F-2	110.12	1675.69
P-3	105.98	2041.69	P-3	69.85	2313.34

ANALYSIS

SUBJ	C CELL VALUE	D CELL VALUE	DIFFERENCE (C - D)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
T-1	1274.54	1599.32	-324.78	15.00	15.00	0.00
A-2	1574.05	1686.29	-112.24	7.00	7.00	0.00
J-4	1710.97	2086.88	-375.91	16.00	16.00	0.00
G-3	1558.40	2043.45	-485.05	18.00	18.00	0.00
B-2	1660.56	1661.17	-0.61	1.00	1.00	0.00
E-2	1941.48	1940.10	1.38	2.00	0.00	2.00
K-1	1826.49	1948.69	-122.20	8.00	8.00	0.00
W-4	1977.04	2402.03	-424.99	17.00	17.00	0.00
B-4	1878.70	1945.95	-67.25	4.00	4.00	0.00
A-3	1406.84	1411.40	-4.56	3.00	3.00	0.00
B-3	1666.00	1739.56	-73.56	6.00	6.00	0.00
H-6	1820.11	1981.96	-161.85	10.00	10.00	0.00
C-2	1969.71	2188.78	-219.07	13.00	13.00	0.00
B-1	1537.53	1726.67	-189.14	12.00	12.00	0.00
M13	1593.81	1410.50	183.31	11.00	0.00	11.00
J-3	1662.88	1819.30	-156.42	9.00	9.00	0.00
F-2	1492.44	1565.57	-73.13	5.00	5.00	0.00
P-3	1935.71	2243.49	-307.78	14.00	14.00	0.00

MEAN C: 1693.74    STD DEV C: 204.77    SUM OF NEG RANKS: 158.00    -----  
 MEAN D: 1855.62    STD DEV D: 279.90    SUM OF POS RANKS: -----    13.00

THERE IS A 10% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON C-D

## ANALYSIS OF VERTICAL SEAT LOAD

(IMPACT MAXIMUM MINUS IMMEDIATE PREIMPACT)

### DATA

CONDITION C			CONDITION D		
SUBJ	IMMEDIATE PREIMPACT	IMPACT MAXIMUM	SUBJ	IMMEDIATE PREIMPACT	IMPACT MAXIMUM
T-1	258.10	1296.41	T-1	258.91	1567.69
A-2	145.57	1338.94	A-2	153.89	1491.50
J-4	323.29	1790.72	J-4	348.15	2073.04
G-3	187.86	1318.46	G-3	196.06	1694.17
B-2	216.76	1547.87	B-2	247.76	1778.39
E-2	197.30	1741.89	E-2	231.91	1818.26
K-1	244.50	1724.25	K-1	195.65	1793.27
W-4	237.16	1942.63	W-4	37.05	2292.87
B-4	177.09	1598.70	B-4	1.28	1910.11
A-3	215.51	1287.31	A-3	224.67	1297.39
B-3	312.28	1796.01	B-3	328.18	1780.58
H-6	206.85	1740.07	H-6	198.37	1914.91
C-2	171.27	1619.89	C-2	187.14	1920.45
B-1	172.67	1390.38	B-1	180.16	1496.00
M13	183.93	1230.52	M13	280.32	1389.13
J-3	226.10	1529.82	J-3	212.60	1614.05
F-2	180.97	1313.41	F-2	235.55	1388.45
P-3	236.40	1724.45	P-3	259.14	2075.59

### ANALYSIS

SUBJ	C CELL VALUE	D CELL VALUE	DIFFERENCE (C - D)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
T-1	1038.31	1308.78	-270.47	13.00	13.00	0.00
A-2	1193.37	1337.61	-144.24	9.00	9.00	0.00
J-4	1467.43	1724.89	-257.46	12.00	12.00	0.00
G-3	1130.60	1498.11	-367.51	16.00	16.00	0.00
B-2	1331.11	1530.63	-199.52	11.00	11.00	0.00
E-2	1544.59	1586.35	-41.76	4.00	4.00	0.00
K-1	1479.75	1597.62	-117.87	8.00	8.00	0.00
W-4	1705.47	2255.82	-550.35	18.00	18.00	0.00
B-4	1421.61	1908.83	-487.22	17.00	17.00	0.00
A-3	1071.80	1072.72	-0.92	1.00	1.00	0.00
B-3	1483.73	1452.40	31.33	3.00	0.00	3.00
H-6	1533.22	1716.54	-183.32	10.00	10.00	0.00
C-2	1448.62	1733.31	-284.69	14.00	14.00	0.00
B-1	1217.71	1315.84	-98.13	7.00	7.00	0.00
M13	1046.59	1108.81	-62.22	5.00	5.00	0.00
J-3	1303.72	1401.45	-97.73	6.00	6.00	0.00
F-2	1132.44	1152.90	-20.46	2.00	2.00	0.00
P-3	1488.05	1816.45	-328.40	15.00	15.00	0.00

MEAN C: 1335.45    STD DEV C: 200.44    SUM OF NEG RANKS: 168.00    -----  
 MEAN D: 1528.84    STD DEV D: 302.76    SUM OF POS RANKS: -----    3.00

THERE IS A 14% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON A-C

## ANALYSIS OF CHEST X ACCELERATION (G)

(IMPACT MINIMUM)

SUBJ	A CELL VALUE	C CELL VALUE	DIFFERENCE (A - C)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
A-2	-18.56	-14.00	-4.56	4.00	4.00	0.00
B-3	-16.42	-10.88	-5.54	6.00	6.00	0.00
P-3	-20.69	-13.11	-7.58	9.00	9.00	0.00
C-2	-24.14	-13.83	-10.31	13.00	13.00	0.00
J-3	-11.89	-12.44	0.55	1.00	0.00	1.00
B-2	-18.92	-12.57	-6.35	7.00	7.00	0.00
J-4	-16.67	-12.39	-4.28	2.00	2.00	0.00
G-3	-20.08	-10.03	-10.05	12.00	12.00	0.00
M13	-17.52	-13.13	-4.39	3.00	3.00	0.00
A-3	-21.26	-12.57	-8.69	10.00	10.00	0.00
B-1	-22.93	-14.22	-8.71	11.00	11.00	0.00
H-6	-31.21	-13.53	-17.68	14.00	14.00	0.00
W-4	-32.43	-14.31	-18.12	15.00	15.00	0.00
K-1	-18.93	-13.91	-5.02	5.00	5.00	0.00
F-2	-19.32	-12.67	-6.65	8.00	8.00	0.00

MEAN A: -20.73 STD DEV A: 5.35 SUM OF NEG RANKS: 119.00 -----  
 MEAN C: -12.91 STD DEV C: 1.21 SUM OF POS RANKS: ----- 1.00

THERE IS A 60% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON A-C

## ANALYSIS OF CHEST Z ACCELERATION (G)

(IMPACT MAXIMUM)

SUBJ	A CELL VALUE	C CELL VALUE	DIFFERENCE (A - C)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
A-2	16.97	7.91	9.06	12.00	0.00	12.00
B-3	15.01	9.77	5.24	9.00	0.00	9.00
P-3	23.43	22.47	0.96	3.00	0.00	3.00
C-2	17.99	18.59	-0.60	2.00	2.00	0.00
J-3	13.91	8.43	5.48	10.00	0.00	10.00
B-2	17.83	9.26	8.57	11.00	0.00	11.00
J-4	12.11	9.20	2.91	6.00	0.00	6.00
G-3	12.86	15.11	-2.25	4.00	4.00	0.00
M13	9.12	8.89	0.23	1.00	0.00	1.00
A-3	10.67	8.06	2.61	5.00	0.00	5.00
B-1	17.93	7.72	10.21	14.00	0.00	14.00
H-6	21.51	7.74	13.77	15.00	0.00	15.00
W-4	15.15	11.90	3.25	7.00	0.00	7.00
K-1	15.79	10.58	5.21	8.00	0.00	8.00
F-2	10.58	19.80	-9.22	13.00	13.00	0.00

MEAN A: 15.39 STD DEV A: 4.04 SUM OF NEG RANKS: 19.00 -----  
 MEAN C: 11.70 STD DEV C: 4.90 SUM OF POS RANKS: ----- 101.00

THERE IS A 32% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.02$ ).

# WILCOXON COMPARISON A-C

## ANALYSIS OF CHEST RESULTANT ACCELERATION (G)

(IMPACT MAXIMUM)

SUBJ	A CELL VALUE	C CELL VALUE	DIFFERENCE (A - C)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
A-2	19.45	15.94	3.51	3.00	0.00	3.00
B-3	20.53	13.79	6.74	7.00	0.00	7.00
P-3	27.97	22.56	5.41	5.00	0.00	5.00
C-2	29.39	18.66	10.73	11.00	0.00	11.00
J-3	18.63	14.70	3.93	4.00	0.00	4.00
B-2	25.84	14.94	10.90	12.00	0.00	12.00
J-4	20.42	13.75	6.67	6.00	0.00	6.00
G-3	23.87	15.62	8.25	9.00	0.00	9.00
M13	17.77	14.99	2.78	2.00	0.00	2.00
A-3	23.12	14.34	8.78	10.00	0.00	10.00
B-1	28.51	15.77	12.74	13.00	0.00	13.00
H-6	32.07	15.46	16.61	14.00	0.00	14.00
W-4	34.74	16.64	18.10	15.00	0.00	15.00
K-1	23.86	15.91	7.95	8.00	0.00	8.00
F-2	21.84	19.89	1.95	1.00	0.00	1.00

MEAN A: 24.53 STO DEV A: 5.09 SUM OF NEG RANKS: 0.00  
 MEAN C: 16.20 STO DEV C: 2.42 SUM OF POS RANKS: 120.00

THERE IS A 51% INCREASE IN THE PARAMETER MEAN ( $2\sigma \leq 0.01$ ).

# WILCOXON COMPARISON A-C

## ANALYSIS OF CHEST SEVERITY INDEX

(IMPACT MAXIMUM)

SUBJ	A CELL VALUE	C CELL VALUE	DIFFERENCE (A - C)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
A-2	63.87	38.15	25.72	9.00	0.00	9.00
B-3	53.22	32.19	21.03	6.00	0.00	6.00
P-3	72.12	59.31	12.81	2.00	0.00	2.00
C-2	84.25	49.58	34.67	11.00	0.00	11.00
J-3	44.88	29.32	15.56	4.00	0.00	4.00
B-2	70.41	36.55	33.86	10.00	0.00	10.00
J-4	48.50	29.38	19.12	5.00	0.00	5.00
G-3	56.84	33.56	23.28	8.00	0.00	8.00
M13	46.26	33.16	13.10	3.00	0.00	3.00
A-3	64.13	29.07	35.06	12.00	0.00	12.00
B-1	77.69	36.21	41.48	13.00	0.00	13.00
H-6	107.51	30.55	76.96	15.00	0.00	15.00
W-4	90.81	41.65	49.16	14.00	0.00	14.00
K-1	58.69	36.48	22.21	7.00	0.00	7.00
F-2	52.70	49.85	2.85	1.00	0.00	1.00

MEAN A: 66.13 STO DEV A: 17.91 SUM OF NEG RANKS: 0.00  
 MEAN C: 37.67 STO DEV C: 8.90 SUM OF POS RANKS: 120.00

THERE IS A 75% INCREASE IN THE PARAMETER MEAN ( $2\sigma \leq 0.01$ ).

# WILCOXON COMPARISON A-C

ANALYSIS OF HEAD Z ACCELERATION (G)

(IMPACT MINIMUM)

SUBJ	A CELL VALUE	C CELL VALUE	DIFFERENCE (A - C)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
A-2	-13.34	-15.07	1.73	4.00	0.00	4.00
B-3	-6.33	-5.42	-0.91	1.00	1.00	0.00
P-3	-12.38	-10.47	-1.91	5.00	5.00	0.00
C-2	-14.02	-11.99	-2.03	7.00	7.00	0.00
J-3	-14.98	-11.09	-3.89	10.00	10.00	0.00
B-2	-12.12	-10.79	-1.33	3.00	3.00	0.00
J-4	-2.75	-0.36	-2.39	8.00	8.00	0.00
G-3	-11.88	-10.67	-1.21	2.00	2.00	0.00
M13	-14.44	-12.42	-2.02	6.00	6.00	0.00
A-3	-11.20	-5.42	-5.78	12.00	12.00	0.00
B-1	-17.90	-13.66	-4.24	11.00	11.00	0.00
H-6	-9.88	-3.13	-6.75	14.00	14.00	0.00
W-4	-14.34	-6.56	-7.78	15.00	15.00	0.00
K-1	-10.27	-6.74	-3.53	9.00	9.00	0.00
F-2	-7.42	-13.83	6.41	13.00	0.00	13.00

MEAN A: -11.55 STD DEV A: 3.83 SUM OF NEG RANKS: 103.00  
 MEAN C: -9.17 STD DEV C: 4.31 SUM OF POS RANKS: 17.00

THERE IS A 26% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.02$ ).

# WILCOXON COMPARISON A-C

ANALYSIS OF TOTAL SHOULDER STRAP LOAD (LB)

(IMPACT MAXIMUM MINUS IMMEDIATE PREIMPACT)

DATA

CONDITION A			CONDITION C		
SUBJ	IMMEDIATE PREIMPACT	IMPACT MAXIMUM	SUBJ	IMMEDIATE PREIMPACT	IMPACT MAXIMUM
A-2	33.54	772.71	A-2	21.37	708.27
B-3	21.76	688.17	B-3	64.75	578.16
P-3	63.05	795.02	P-3	32.78	774.88
C-2	31.11	832.41	C-2	21.53	723.09
J-3	49.59	537.20	J-3	59.02	533.56
B-2	63.13	753.02	B-2	35.01	731.43
J-4	66.09	570.72	J-4	95.67	649.16
G-3	36.59	700.31	G-3	48.32	663.56
M13	48.88	679.60	M13	24.04	567.19
A-3	41.49	757.25	A-3	74.36	632.13
B-1	24.99	595.02	B-1	35.10	558.58
H-6	35.17	969.05	H-6	38.96	799.67
W-4	39.88	734.85	W-4	58.35	680.73
K-1	41.31	788.76	K-1	37.26	619.20
F-2	59.48	579.89	F-2	52.60	578.71

ANALYSIS

SUBJ	A CELL VALUE	C CELL VALUE	DIFFERENCE (A - C)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
A-2	739.17	686.90	52.27	8.00	0.00	8.00
B-3	666.41	513.40	153.01	12.00	0.00	12.00
P-3	731.97	742.10	-10.13	3.00	3.00	0.00
C-2	801.30	701.56	99.74	11.00	0.00	11.00
J-3	487.61	474.54	13.07	4.00	0.00	4.00
B-2	689.89	696.42	-6.53	2.00	2.00	0.00
J-4	504.63	553.49	-48.86	7.00	7.00	0.00
G-3	663.72	615.24	48.48	6.00	0.00	6.00
M13	630.72	543.15	87.57	10.00	0.00	10.00
A-3	715.76	557.77	157.99	13.00	0.00	13.00
B-1	570.03	523.48	46.55	5.00	0.00	5.00
H-6	933.88	760.71	173.17	15.00	0.00	15.00
W-4	694.97	622.38	72.59	9.00	0.00	9.00
K-1	747.45	581.94	165.51	14.00	0.00	14.00
F-2	520.41	526.11	-5.70	1.00	1.00	0.00

MEAN A: 673.19 STD DEV A: 119.23 SUM OF NEG RANKS: 13.00  
 MEAN C: 606.61 STD DEV C: 90.76 SUM OF POS RANKS: 107.00

THERE IS A 11% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON A-C

ANALYSIS OF TOTAL LAP BELT LOAD (LB)

(IMPACT MAXIMUM MINUS IMMEDIATE PREIMPACT)

## DATA

CONDITION A			CONDITION C		
SUBJ	IMMEDIATE PREIMPACT	IMPACT MAXIMUM	SUBJ	IMMEDIATE PREIMPACT	IMPACT MAXIMUM
A-2	50.19	1596.89	A-2	48.59	1622.64
B-3	191.94	2163.14	B-3	263.19	1929.19
P-3	118.26	2047.72	P-3	105.98	2041.69
C-2	59.79	2364.02	C-2	40.88	2010.59
J-3	222.45	1666.16	J-3	170.63	1833.51
B-2	83.81	1967.23	B-2	88.62	1749.18
J-4	194.52	2271.52	J-4	244.60	1955.57
G-3	82.52	2081.55	G-3	115.91	1674.31
M13	151.52	1792.71	M13	103.57	1697.38
A-3	64.76	2033.21	A-3	193.53	1600.37
B-1	89.63	1708.65	B-1	99.83	1637.36
H-6	61.29	2239.19	H-6	101.28	1921.39
W-4	76.09	2564.78	W-4	131.22	2108.26
K-1	122.38	2099.22	K-1	183.72	2010.21
F-2	141.26	1923.34	F-2	136.94	1629.38

## ANALYSIS

SUBJ	A CELL VALUE	C CELL VALUE	DIFFERENCE (A - C)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
A-2	1546.70	1574.05	-27.35	2.00	2.00	0.00
B-3	1971.20	1666.00	305.20	9.00	0.00	9.00
P-3	1929.46	1935.71	-6.25	1.00	1.00	0.00
C-2	2304.23	1969.71	334.52	10.00	0.00	10.00
J-3	1443.71	1662.88	-219.17	6.00	6.00	0.00
B-2	1883.42	1660.56	222.86	7.00	0.00	7.00
J-4	2077.00	1710.97	366.03	12.00	0.00	12.00
G-3	1999.03	1558.40	440.63	13.00	0.00	13.00
M13	1641.19	1593.81	47.38	3.00	0.00	3.00
A-3	1968.45	1408.84	561.61	15.00	0.00	15.00
B-1	1619.02	1537.53	81.49	4.00	0.00	4.00
H-6	2177.90	1820.11	357.79	11.00	0.00	11.00
W-4	2488.69	1977.04	511.65	14.00	0.00	14.00
K-1	1976.84	1826.49	150.35	5.00	0.00	5.00
F-2	1782.08	1482.44	289.64	8.00	0.00	8.00

MEAN A: 1920.59 STD DEV A: 284.31 SUM OF NEG RANKS: 9.00  
 MEAN C: 1692.84 STD DEV C: 177.59 SUM OF POS RANKS: 111.00

THERE IS A 14% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).



# WILCOXON COMPARISON A-C

## ANALYSIS OF VERTICAL SEAT LOAD

(IMPACT MAXIMUM MINUS IMMEDIATE PREIMPACT)

### DATA

CONDITION A			CONDITION C		
SUBJ	IMMEDIATE PREIMPACT	IMPACT MAXIMUM	SUBJ	IMMEDIATE PREIMPACT	IMPACT MAXIMUM
A-2	136.14	1346.30	A-2	145.57	1338.94
B-3	282.86	1926.48	B-3	312.28	1796.01
P-3	231.48	1756.25	P-3	236.40	1724.45
C-2	186.48	1894.57	C-2	171.27	1619.89
J-3	272.59	1579.27	J-3	226.10	1529.82
B-2	205.77	1774.46	B-2	216.76	1547.87
J-4	302.92	2091.06	J-4	323.29	1790.72
G-3	180.96	1568.66	G-3	187.86	1318.46
M13	206.42	1407.50	M13	183.93	1230.52
A-3	154.48	1459.78	A-3	215.51	1287.31
B-1	152.24	1322.22	B-1	172.67	1390.38
H-6	189.08	1784.56	H-6	206.85	1740.07
W-4	213.15	2177.86	W-4	237.16	1942.63
K-1	190.91	1761.99	K-1	244.50	1724.25
F-2	195.48	1483.20	F-2	180.97	1313.41

### ANALYSIS

SUBJ	A CELL VALUE	C CELL VALUE	DIFFERENCE (A - C)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
A-2	1210.16	1193.37	16.79	2.00	0.00	2.00
B-3	1643.62	1483.73	159.89	9.00	0.00	9.00
P-3	1524.77	1488.05	36.72	3.00	0.00	3.00
C-2	1708.09	1448.62	259.47	14.00	0.00	14.00
J-3	1306.68	1303.72	2.96	1.00	0.00	1.00
B-2	1568.69	1331.11	237.58	11.00	0.00	11.00
J-4	1788.14	1467.43	320.71	15.00	0.00	15.00
G-3	1387.70	1130.60	257.10	12.00	0.00	12.00
M13	1201.08	1046.59	154.49	7.00	0.00	7.00
A-3	1305.30	1071.80	233.50	10.00	0.00	10.00
B-1	1169.98	1217.71	-47.73	4.00	4.00	0.00
H-6	1595.48	1533.22	62.26	5.00	0.00	5.00
W-4	1964.71	1705.47	259.24	13.00	0.00	13.00
K-1	1571.08	1479.75	91.33	6.00	0.00	6.00
F-2	1287.72	1132.44	155.28	8.00	0.00	8.00

MEAN A: 1482.21 STD DEV A: 237.98 SUM OF NEG RANKS: 4.00  
 MEAN C: 1335.57 STD DEV C: 197.04 SUM OF POS RANKS: 116.00

THERE IS A 10% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON B-D

## ANALYSIS OF CHEST X ACCELERATION (G)

(IMPACT MINIMUM)

SUBJ	B CELL VALUE	D CELL VALUE	DIFFERENCE (B - D)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
J-3	-15.26	-15.60	0.34	2.00	0.00	2.00
A-3	-19.68	-13.62	-6.06	5.00	5.00	0.00
F-2	-21.92	-15.55	-6.37	7.00	7.00	0.00
A-2	-26.86	-19.45	-7.41	8.00	8.00	0.00
B-1	-19.81	-19.56	-0.25	1.00	1.00	0.00
K-1	-20.44	-14.35	-6.09	6.00	6.00	0.00
C-2	-27.05	-19.47	-7.58	9.00	9.00	0.00
G-3	-25.45	-15.45	-10.00	12.00	12.00	0.00
B-3	-21.61	-12.49	-9.12	11.00	11.00	0.00
T-1	-29.21	-14.78	-14.43	13.00	13.00	0.00
B-2	-28.64	-14.08	-14.56	14.00	14.00	0.00
J-4	-17.78	-16.54	-1.24	3.00	3.00	0.00
P-3	-13.93	-17.26	3.33	4.00	0.00	4.00
W-4	-26.68	-18.58	-8.10	10.00	10.00	0.00

MEAN B: -22.45 STD DEV B: 4.94 SUM OF NEG RANKS: 99.00  
 MEAN D: -16.20 STD DEV D: 2.34 SUM OF POS RANKS: 6.00

THERE IS A 39% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON B-D

## ANALYSIS OF CHEST Z ACCELERATION (G)

(IMPACT MAXIMUM)

SUBJ	B CELL VALUE	D CELL VALUE	DIFFERENCE (B - D)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
J-3	15.40	10.05	5.35	7.00	0.00	7.00
A-3	11.82	7.60	4.22	5.00	0.00	5.00
F-2	12.29	11.69	0.60	1.00	0.00	1.00
A-2	17.74	7.53	10.21	12.00	0.00	12.00
B-1	13.75	11.71	2.04	2.00	0.00	2.00
K-1	18.12	12.08	6.04	8.00	0.00	8.00
C-2	27.25	9.45	17.80	14.00	0.00	14.00
G-3	12.24	14.53	-2.29	3.00	3.00	0.00
B-3	17.17	10.60	6.57	10.00	0.00	10.00
T-1	10.08	6.18	3.90	4.00	0.00	4.00
B-2	20.39	10.34	10.05	11.00	0.00	11.00
J-4	13.18	7.07	6.11	9.00	0.00	9.00
P-3	16.48	12.16	4.32	6.00	0.00	6.00
W-4	23.92	7.43	16.49	13.00	0.00	13.00

MEAN B: 16.42 STD DEV B: 4.88 SUM OF NEG RANKS: 3.00  
 MEAN D: 9.89 STD DEV D: 2.44 SUM OF POS RANKS: 102.00

THERE IS A 66% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON B-D

## ANALYSIS OF CHEST RESULTANT ACCELERATION (G)

(IMPACT MAXIMUM)

SUBJ	B CELL VALUE	D CELL VALUE	DIFFERENCE (B - D)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
J-3	20.95	16.63	4.32	4.00	0.00	4.00
A-3	22.17	14.13	8.04	7.00	0.00	7.00
F-2	23.62	15.79	7.83	6.00	0.00	6.00
A-2	27.25	20.82	6.43	5.00	0.00	5.00
B-1	22.82	19.85	2.97	3.00	0.00	3.00
K-1	27.27	15.39	11.88	10.00	0.00	10.00
C-2	35.80	20.18	15.62	14.00	0.00	14.00
G-3	25.74	17.29	8.45	8.00	0.00	8.00
B-3	25.25	15.32	9.93	9.00	0.00	9.00
T-1	30.91	15.71	15.20	12.00	0.00	12.00
B-2	31.96	16.58	15.38	13.00	0.00	13.00
J-4	19.15	17.50	1.65	1.00	0.00	1.00
P-3	20.94	18.17	2.77	2.00	0.00	2.00
W-4	33.30	18.95	14.35	11.00	0.00	11.00

MEAN B: 26.22 STD DEV B: 5.12 SUM OF NEG RANKS: 0.00  
 MEAN D: 17.31 STD DEV D: 2.04 SUM OF POS RANKS: 105.00

THERE IS A 51% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON B-D

## ANALYSIS OF CHEST SEVERITY INDEX

(IMPACT MAXIMUM)

SUBJ	B CELL VALUE	D CELL VALUE	DIFFERENCE (B - D)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
J-3	48.08	41.25	6.83	3.00	0.00	3.00
A-3	63.51	32.56	30.95	9.00	0.00	9.00
F-2	58.31	37.23	21.08	7.00	0.00	7.00
A-2	88.87	46.90	41.97	11.00	0.00	11.00
B-1	58.55	52.36	6.19	2.00	0.00	2.00
K-1	65.17	47.53	17.64	5.00	0.00	5.00
C-2	111.68	48.73	62.95	14.00	0.00	14.00
G-3	64.76	47.35	17.41	4.00	0.00	4.00
B-3	63.71	35.23	28.48	8.00	0.00	8.00
T-1	86.44	34.36	52.08	12.00	0.00	12.00
B-2	99.33	38.16	61.17	13.00	0.00	13.00
J-4	57.86	38.51	19.35	6.00	0.00	6.00
P-3	54.37	53.86	0.51	1.00	0.00	1.00
W-4	91.00	51.22	39.78	10.00	0.00	10.00

MEAN B: 72.26 STD DEV B: 19.35 SUM OF NEG RANKS: 0.00  
 MEAN D: 43.23 STD DEV D: 7.25 SUM OF POS RANKS: 105.00

THERE IS A 67% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON B-D

ANALYSIS OF TOTAL LAP BELT LOAD (LB)

(IMPACT MAXIMUM MINUS IMMEDIATE PREIMPACT)

DATA

CONDITION B			CONDITION D		
SUBJ	IMMEDIATE PREIMPACT	IMPACT MAXIMUM	SUBJ	IMMEDIATE PREIMPACT	IMPACT MAXIMUM
J-3	156.55	1775.16	J-3	94.19	1913.49
A-3	104.79	1964.63	A-3	131.57	1542.97
F-2	81.39	2046.09	F-2	110.12	1675.69
A-2	35.97	1684.77	A-2	41.59	1727.88
B-1	99.06	1668.50	B-1	54.75	1781.42
K-1	121.22	2195.75	K-1	62.05	2010.74
C-2	28.85	2675.66	C-2	33.31	2222.09
G-3	49.26	2303.92	G-3	57.41	2100.86
B-3	144.73	2095.40	B-3	174.73	1914.29
T-1	69.48	2158.64	T-1	113.58	1712.90
B-2	58.31	2690.17	B-2	80.09	1741.26
J-4	149.98	2433.91	J-4	173.35	2260.23
P-3	78.63	2249.54	P-3	69.85	2313.34
W-4	88.88	2642.44	W-4	25.46	2427.49

ANALYSIS

SUBJ	B CELL VALUE	D CELL VALUE	DIFFERENCE (B - D)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
J-3	1618.61	1819.30	-200.69	7.00	7.00	0.00
A-3	1859.84	1411.40	448.44	11.00	0.00	11.00
F-2	1964.70	1565.57	399.13	10.00	0.00	10.00
A-2	1648.80	1686.29	-37.49	1.00	1.00	0.00
B-1	1569.44	1726.67	-157.23	5.00	5.00	0.00
K-1	2074.53	1948.69	125.84	3.00	0.00	3.00
C-2	2646.81	2188.78	458.03	12.00	0.00	12.00
G-3	2254.66	2043.45	211.21	9.00	0.00	9.00
B-3	1950.67	1739.56	211.11	8.00	0.00	8.00
T-1	2089.16	1599.32	489.84	13.00	0.00	13.00
B-2	2631.86	1661.17	970.69	14.00	0.00	14.00
J-4	2283.93	2086.88	197.05	6.00	0.00	6.00
P-3	2170.91	2243.49	-72.58	2.00	2.00	0.00
W-4	2553.56	2402.03	151.53	4.00	0.00	4.00

MEAN B: 2094.11    STD DEV B: 357.96    SUM OF NEG RANKS: 15.00  
 MEAN D: 1865.90    STD DEV D: 291.02    SUM OF POS RANKS: 90.00

THERE IS A 12% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.02$ ).

# WILCOXON COMPARISON B-D

ANALYSIS OF NEGATIVE G STRAP LOAD (LB)

(IMPACT MAXIMUM MINUS IMMEDIATE PREIMPACT)

DATA

CONDITION B			CONDITION D		
SUBJ	IMMEDIATE PREIMPACT	IMPACT MAXIMUM	SUBJ	IMMEDIATE PREIMPACT	IMPACT MAXIMUM
J-3	20.02	77.28	J-3	48.02	179.80
A-3	2.84	116.78	A-3	56.85	203.91
F-2	10.29	160.04	F-2	71.25	194.38
A-2	2.01	112.34	A-2	21.63	257.96
B-1	5.47	94.42	B-1	45.48	323.91
K-1	23.37	95.65	K-1	36.93	255.01
C-2	7.46	152.71	C-2	25.36	272.61
G-3	9.33	197.83	G-3	47.43	245.23
B-3	13.90	138.46	B-3	73.86	290.00
T-1	11.42	168.07	T-1	79.83	267.59
B-2	5.82	224.76	B-2	51.05	289.64
J-4	22.84	117.29	J-4	106.25	237.85
P-3	14.54	165.76	P-3	49.68	232.54
W-4	31.98	259.93	W-4	0.04	437.68

ANALYSIS

SUBJ	B CELL VALUE	D CELL VALUE	DIFFERENCE (B - D)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
J-3	57.26	131.78	-74.52	8.00	8.00	0.00
A-3	113.94	147.06	-33.12	6.00	6.00	0.00
F-2	149.75	123.13	26.62	3.00	0.00	3.00
A-2	110.33	236.33	-126.00	11.00	11.00	0.00
B-1	88.95	278.43	-189.48	13.00	13.00	0.00
K-1	72.28	218.08	-145.80	12.00	12.00	0.00
C-2	145.25	247.25	-102.00	10.00	10.00	0.00
G-3	188.50	197.80	-9.30	1.00	1.00	0.00
B-3	124.56	216.14	-91.58	9.00	9.00	0.00
T-1	156.65	187.76	-31.11	4.00	4.00	0.00
B-2	218.94	238.59	-19.65	2.00	2.00	0.00
J-4	94.45	131.60	-37.15	7.00	7.00	0.00
P-3	151.22	182.86	-31.64	5.00	5.00	0.00
W-4	227.95	437.64	-209.69	14.00	14.00	0.00

MEAN B: 135.72 STD DEV B: 51.51 SUM OF NEG RANKS: 102.00  
 MEAN D: 212.46 STD DEV D: 80.66 SUM OF POS RANKS: -----

3.00

THERE IS A 56% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON E-F

## ANALYSIS OF CARRIAGE VELOCITY (FT/SEC)

(IMPACT MINIMUM)

SUBJ	E CELL VALUE	F CELL VALUE	DIFFERENCE (E - F)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
H-6	-26.03	-26.37	0.34	13.00	0.00	13.00
B-1	-25.94	-26.42	0.48	15.00	0.00	15.00
P-3	-26.31	-26.25	-0.06	6.00	6.00	0.00
M-4	-26.15	-26.34	0.19	11.00	0.00	11.00
C-2	-26.26	-26.39	0.13	9.00	0.00	9.00
B-3	-26.17	-26.28	0.11	7.50	0.00	7.50
M13	-26.23	-26.48	0.25	12.00	0.00	12.00
J-4	-26.25	-26.26	0.01	1.00	0.00	1.00
M-3	-26.31	-26.36	0.05	4.50	0.00	4.50
A-3	-26.21	-26.32	0.11	7.50	0.00	7.50
K-1	-26.36	-26.23	-0.13	10.00	10.00	0.00
S-6	-26.25	-26.27	0.02	2.50	0.00	2.50
A-2	-26.36	-26.76	0.40	14.00	0.00	14.00
B-2	-26.22	-26.22	0.00	0.00	0.00	0.00
C-1	-26.27	-26.25	-0.02	2.50	2.50	0.00
T-1	-26.28	-26.23	-0.05	4.50	4.50	0.00

MEAN E: -26.23 STD DEV E: 0.11 SUM OF NEG RANKS: 23.00 -----  
 MEAN F: -26.34 STD DEV F: 0.14 SUM OF POS RANKS: ----- 97.00

THERE IS A 0.4% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.05$ ).

# WILCOXON COMPARISON E-F

## ANALYSIS OF HEAD SEVERITY INDEX

(IMPACT MAXIMUM)

SUBJ	E CELL VALUE	F CELL VALUE	DIFFERENCE (E - F)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
H-6	22.37	24.02	-1.65	8.00	8.00	0.00
B-1	24.60	23.44	1.16	6.00	0.00	6.00
P-3	23.83	23.19	0.64	3.00	0.00	3.00
M-4	22.79	19.97	2.82	13.00	0.00	13.00
C-2	21.87	22.70	-0.83	4.00	4.00	0.00
B-3	21.28	21.68	-0.40	1.00	1.00	0.00
M13	25.64	20.83	4.81	15.00	0.00	15.00
J-4	26.48	23.98	2.50	11.00	0.00	11.00
M-3	26.38	24.49	1.89	9.00	0.00	9.00
A-3	22.69	22.69	0.00	0.00	0.00	0.00
K-1	24.40	21.39	3.01	14.00	0.00	14.00
S-6	19.35	18.06	1.29	7.00	0.00	7.00
A-2	22.22	22.83	-0.61	2.00	2.00	0.00
B-2	21.73	19.12	2.61	12.00	0.00	12.00
C-1	24.98	23.05	1.93	10.00	0.00	10.00
T-1	22.30	23.29	-0.99	5.00	5.00	0.00

MEAN E: 23.31 STD DEV E: 1.98 SUM OF NEG RANKS: 20.00 -----  
 MEAN F: 22.17 STD DEV F: 1.85 SUM OF POS RANKS: ----- 100.00

THERE IS A 5% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.05$ ).

# WILCOXON COMPARISON E-F

## ANALYSIS OF TOTAL LAP BELT LOAD (LB)

(FREEFALL MAXIMUM)

SUBJ	E CELL VALUE	F CELL VALUE	DIFFERENCE (E - F)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
H-6	222.15	225.03	-2.88	2.00	2.00	0.00
B-1	250.77	137.48	113.29	16.00	0.00	16.00
P-3	360.34	356.47	3.87	3.00	0.00	3.00
W-4	285.64	236.93	48.71	14.00	0.00	14.00
C-2	175.56	146.02	29.54	8.00	0.00	8.00
B-3	342.79	308.79	34.00	9.00	0.00	9.00
M13	233.87	272.18	-38.31	10.00	10.00	0.00
J-4	286.68	266.87	19.81	6.00	0.00	6.00
W-3	196.40	186.67	9.73	5.00	0.00	5.00
A-3	285.08	241.52	43.56	12.00	0.00	12.00
K-1	239.94	237.82	2.12	1.00	0.00	1.00
S-6	148.73	177.43	-28.70	7.00	7.00	0.00
A-2	230.43	224.42	6.01	4.00	0.00	4.00
B-2	251.26	212.94	38.32	11.00	0.00	11.00
C-1	362.60	317.98	44.62	13.00	0.00	13.00
T-1	352.06	293.54	58.52	15.00	0.00	15.00

MEAN E: 264.02 STD DEV E: 65.71 SUM OF NEG RANKS: 19.00  
 MEAN F: 240.13 STD DEV F: 61.27 SUM OF POS RANKS: 117.00

THERE IS A 10% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON E-F

ANALYSIS OF TOTAL LAP BELT LOAD (LB)

(IMPACT MAXIMUM MINUS IMPACT MINIMUM)

## DATA

CONDITION E			CONDITION F		
SUBJ	IMPACT MINIMUM	IMPACT MAXIMUM	SUBJ	IMPACT MINIMUM	IMPACT MAXIMUM
H-6	129.25	331.70	H-6	98.91	267.13
B-1	122.84	201.60	B-1	71.96	140.68
P-3	261.73	435.67	P-3	246.33	343.00
W-4	99.70	230.47	W-4	79.86	164.94
C-2	110.47	201.08	C-2	101.37	180.13
B-3	167.06	277.20	B-3	112.07	174.03
M13	105.03	195.92	M13	203.93	310.13
J-4	130.94	277.55	J-4	123.65	242.95
W-3	97.41	156.37	W-3	89.96	182.91
A-3	167.28	234.94	A-3	139.54	219.96
K-1	60.82	163.00	K-1	72.92	143.90
S-6	86.48	199.97	S-6	110.86	192.39
A-2	111.88	265.82	A-2	112.47	180.90
B-2	107.57	197.92	B-2	52.39	149.92
C-1	179.84	264.62	C-1	170.88	258.58
T-1	176.62	248.68	T-1	142.30	193.63

## ANALYSIS

SUBJ	E CELL VALUE	F CELL VALUE	DIFFERENCE (E - F)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
H-6	202.45	168.22	34.23	12.00	0.00	12.00
B-1	78.76	68.72	10.04	3.00	0.00	3.00
P-3	173.94	96.67	77.27	15.00	0.00	15.00
W-4	130.77	85.08	45.69	13.00	0.00	13.00
C-2	90.61	78.76	11.85	4.00	0.00	4.00
B-3	110.14	61.96	48.18	14.00	0.00	14.00
M13	90.89	106.20	-15.31	6.00	6.00	0.00
J-4	146.61	119.30	27.31	8.00	0.00	8.00
W-3	58.96	92.95	-33.99	11.00	11.00	0.00
A-3	67.66	80.42	-12.76	5.00	5.00	0.00
K-1	102.18	70.98	31.20	9.00	0.00	9.00
S-6	113.49	81.53	31.96	10.00	0.00	10.00
A-2	153.94	68.43	85.51	16.00	0.00	16.00
B-2	90.35	97.53	-7.18	2.00	2.00	0.00
C-1	84.78	87.70	-2.92	1.00	1.00	0.00
T-1	72.06	51.33	20.73	7.00	0.00	7.00

MEAN E: 110.47 STD DEV E: 40.81 SUM OF NEG RANKS: 25.00 -----  
 MEAN F: 88.49 STD DEV F: 27.32 SUM OF POS RANKS: ----- 111.00

THERE IS A 25% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.05$ ).



# WILCOXON COMPARISON E-F

## ANALYSIS OF VERTICAL SEAT LOAD (LB)

(FREEFALL MAXIMUM)

SUBJ	E CELL VALUE	F CELL VALUE	DIFFERENCE (E - F)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
H-6	212.86	263.73	-50.87	11.00	11.00	0.00
B-1	184.49	188.80	-4.31	2.00	2.00	0.00
P-3	333.25	405.88	-72.63	15.00	15.00	0.00
W-4	244.02	309.63	-65.61	13.00	13.00	0.00
C-2	202.18	208.35	-6.17	4.00	4.00	0.00
B-3	274.26	342.07	-67.81	14.00	14.00	0.00
M13	266.32	261.27	5.05	3.00	0.00	3.00
J-4	283.01	393.14	-110.13	16.00	16.00	0.00
W-3	230.88	233.65	-2.77	1.00	1.00	0.00
A-3	266.57	239.41	27.16	8.00	0.00	8.00
K-1	238.22	291.38	-53.16	12.00	12.00	0.00
S-6	128.98	141.81	-12.83	5.00	5.00	0.00
A-2	219.72	249.51	-29.79	9.00	9.00	0.00
B-2	242.51	267.18	-24.67	7.00	7.00	0.00
C-1	302.13	321.68	-19.55	6.00	6.00	0.00
T-1	266.00	305.27	-39.27	10.00	10.00	0.00

MEAN E: 243.46 STD DEV E: 48.69 SUM OF NEG RANKS: 125.00  
 MEAN F: 276.42 STD DEV F: 70.11 SUM OF POS RANKS: 11.00

THERE IS A 14% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON E-F

## ANALYSIS OF RESULTANT SEAT LOAD (LB)

(FREEFALL MAXIMUM)

SUBJ	E CELL VALUE	F CELL VALUE	DIFFERENCE (E - F)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
H-6	212.92	263.96	-51.04	11.00	11.00	0.00
B-1	184.67	205.21	-20.54	7.00	7.00	0.00
P-3	333.59	406.14	-72.55	15.00	15.00	0.00
W-4	244.82	310.01	-65.19	13.00	13.00	0.00
C-2	202.21	208.65	-6.44	2.00	2.00	0.00
B-3	279.05	345.42	-66.37	14.00	14.00	0.00
M13	278.93	277.93	1.00	1.00	0.00	1.00
J-4	285.19	394.01	-108.82	16.00	16.00	0.00
W-3	243.77	237.02	6.75	3.00	0.00	3.00
A-3	266.67	239.42	27.25	8.00	0.00	8.00
K-1	238.30	291.46	-53.16	12.00	12.00	0.00
S-6	128.98	141.84	-12.86	4.00	4.00	0.00
A-2	219.83	251.09	-31.26	9.00	9.00	0.00
B-2	248.96	269.05	-20.09	6.00	6.00	0.00
C-1	305.21	322.19	-16.98	5.00	5.00	0.00
T-1	266.36	305.28	-38.92	10.00	10.00	0.00

MEAN E: 246.22 STD DEV E: 49.64 SUM OF NEG RANKS: 124.00  
 MEAN F: 279.29 STD DEV F: 68.86 SUM OF POS RANKS: 12.00

THERE IS A 13% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON E-F

## ANALYSIS OF VERTICAL SEAT LOAD (LB)

(IMPACT MAXIMUM MINUS FREEFALL MAXIMUM)

### DATA

CONDITION E			CONDITION F		
SUBJ	FREEFALL MAXIMUM	IMPACT MAXIMUM	SUBJ	FREEFALL MAXIMUM	IMPACT MAXIMUM
H-6	212.86	2242.47	H-6	263.73	2361.13
B-1	184.49	2073.44	B-1	188.80	2025.22
P-3	333.25	2671.02	P-3	405.88	2676.05
W-4	244.02	2409.89	W-4	309.63	2367.31
C-2	202.18	2278.64	C-2	208.35	2180.78
B-3	274.26	2359.28	B-3	342.07	2341.32
M13	266.32	2396.51	M13	261.27	2332.14
J-4	283.01	2547.80	J-4	393.14	2512.18
W-3	230.88	2218.02	W-3	233.65	2194.75
A-3	266.57	2124.72	A-3	239.41	2063.21
K-1	238.22	2435.98	K-1	291.38	2372.74
S-6	128.98	1525.85	S-6	141.81	1531.51
A-2	219.72	2055.62	A-2	249.51	2023.19
B-2	242.51	2654.17	B-2	267.18	2798.15
C-1	302.13	2255.03	C-1	321.68	2151.59
T-1	266.00	2339.16	T-1	305.27	2237.40

### ANALYSIS

SUBJ	E CELL VALUE	F CELL VALUE	DIFFERENCE (E - F)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
H-6	2029.61	2097.40	-67.79	8.00	8.00	0.00
B-1	1888.95	1836.42	52.53	4.00	0.00	4.00
P-3	2337.77	2270.17	67.60	7.00	0.00	7.00
W-4	2165.87	2057.68	108.19	11.00	0.00	11.00
C-2	2076.46	1972.43	104.03	10.00	0.00	10.00
B-3	2085.02	1999.25	85.77	9.00	0.00	9.00
M13	2130.19	2070.87	59.32	5.00	0.00	5.00
J-4	2264.79	2119.04	145.75	16.00	0.00	16.00
W-3	1987.14	1961.10	26.04	2.00	0.00	2.00
A-3	1858.15	1823.80	34.35	3.00	0.00	3.00
K-1	2197.76	2081.36	116.40	12.00	0.00	12.00
S-6	1396.87	1389.70	7.17	1.00	0.00	1.00
A-2	1835.90	1773.68	62.22	6.00	0.00	6.00
B-2	2411.66	2530.97	-119.31	13.00	13.00	0.00
C-1	1952.90	1829.91	122.99	14.00	0.00	14.00
T-1	2073.16	1932.13	141.03	15.00	0.00	15.00

MEAN E: 2043.26    STD DEV E: 238.34    SUM OF NEG RANKS: 21.00    -----  
 MEAN F: 1984.12    STD DEV F: 245.87    SUM OF POS RANKS: -----    115.00

THERE IS A 3% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.02$ ).

# WILCOXON COMPARISON E-F

## ANALYSIS OF RESULTANT SEAT LOAD (LB)

(IMPACT MAXIMUM MINUS FREEFALL MAXIMUM)

### DATA

CONDITION E			CONDITION F		
SUBJ	FREEFALL MAXIMUM	IMPACT MAXIMUM	SUBJ	FREEFALL MAXIMUM	IMPACT MAXIMUM
H-6	212.92	2243.68	H-6	263.96	2362.23
B-1	184.67	2074.90	B-1	205.21	2026.29
P-3	333.59	2672.54	P-3	406.14	2677.35
W-4	244.82	2411.76	W-4	310.01	2368.94
C-2	202.21	2279.91	C-2	208.65	2182.25
B-3	279.05	2360.87	B-3	345.42	2343.73
M13	278.93	2396.52	M13	277.93	2333.01
J-4	285.19	2548.56	J-4	394.01	2514.05
W-3	243.77	2218.85	W-3	237.02	2199.40
A-3	266.67	2126.03	A-3	239.42	2063.67
K-1	238.30	2436.76	K-1	291.46	2373.88
S-6	128.98	1525.96	S-6	141.84	1531.86
A-2	219.83	2055.78	A-2	251.09	2024.54
B-2	248.96	2655.29	B-2	269.05	2801.73
C-1	305.21	2257.82	C-1	322.19	2152.82
T-1	266.36	2339.45	T-1	305.28	2237.65

### ANALYSIS

SUBJ	E CELL VALUE	F CELL VALUE	DIFFERENCE (E - F)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
H-6	2030.76	2098.27	-67.51	6.00	6.00	0.00
B-1	1890.23	1821.08	69.15	8.00	0.00	8.00
P-3	2338.95	2271.21	67.74	7.00	0.00	7.00
W-4	2166.94	2058.93	108.01	11.00	0.00	11.00
C-2	2077.70	1973.60	104.10	10.00	0.00	10.00
B-3	2081.82	1998.31	83.51	9.00	0.00	9.00
M13	2117.59	2055.08	62.51	5.00	0.00	5.00
J-4	2263.37	2120.04	143.33	16.00	0.00	16.00
W-3	1975.08	1962.38	12.70	2.00	0.00	2.00
A-3	1859.36	1824.25	35.11	3.00	0.00	3.00
K-1	2198.46	2082.42	116.04	12.00	0.00	12.00
S-6	1396.98	1390.02	6.96	1.00	0.00	1.00
A-2	1835.95	1773.45	62.50	4.00	0.00	4.00
B-2	2406.33	2532.68	-126.35	14.00	14.00	0.00
C-1	1952.61	1830.63	121.98	13.00	0.00	13.00
T-1	2073.09	1932.37	140.72	15.00	0.00	15.00

MEAN E: 2041.58    STD DEV E: 237.63    SUM OF NEG RANKS: 20.00  
 MEAN F: 1982.79    STD DEV F: 246.52    SUM OF POS RANKS: -----

116.00

THERE IS A 3% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.02$ ).

# WILCOXON COMPARISON G-H

## ANALYSIS OF CARRIAGE ACCELERATION (G)

(IMPACT MAXIMUM)

SUBJ	G CELL VALUE	H CELL VALUE	DIFFERENCE (G - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
E-2	10.03	10.04	-0.01	2.00	2.00	0.00
S-6	10.06	10.04	0.02	8.00	0.00	8.00
C-2	10.01	10.01	0.00	0.00	0.00	0.00
M13	10.01	10.04	-0.03	9.00	9.00	0.00
J-4	9.95	9.93	0.02	5.50	0.00	5.50
A-2	9.94	10.02	-0.08	11.00	11.00	0.00
P-3	9.90	9.88	0.02	5.50	0.00	5.50
W-4	9.92	10.03	-0.11	13.50	13.50	0.00
B-1	9.92	10.03	-0.11	13.50	13.50	0.00
H-6	9.94	10.03	-0.09	12.00	12.00	0.00
K-1	9.95	9.94	0.01	2.00	0.00	2.00
W-3	9.95	9.96	-0.01	2.00	2.00	0.00
C-1	9.96	10.00	-0.04	10.00	10.00	0.00
B-3	10.02	10.04	-0.02	5.50	5.50	0.00
B-2	9.97	9.99	-0.02	5.50	5.50	0.00

MEAN G: 9.97 STD DEV G: 0.05 SUM OF NEG RANKS: 84.00  
 MEAN H: 10.00 STD DEV H: 0.05 SUM OF POS RANKS: 21.00

THERE IS A 0.3% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.05$ ).

# WILCOXON COMPARISON G-H

## ANALYSIS OF CHEST Z ACCELERATION (G)

(IMPACT MAXIMUM)

SUBJ	G CELL VALUE	H CELL VALUE	DIFFERENCE (G - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
E-2	15.12	14.61	0.51	5.00	0.00	5.00
S-6	21.82	13.73	8.09	15.00	0.00	15.00
C-2	15.48	14.22	1.26	11.00	0.00	11.00
M13	14.88	15.98	-1.10	9.00	9.00	0.00
J-4	16.44	15.96	0.48	4.00	0.00	4.00
A-2	15.90	13.72	2.18	12.00	0.00	12.00
P-3	16.16	15.08	1.08	8.00	0.00	8.00
W-4	16.29	16.07	0.22	2.00	0.00	2.00
B-1	16.25	16.21	0.04	1.00	0.00	1.00
H-6	17.85	14.01	3.84	14.00	0.00	14.00
K-1	14.64	15.49	-0.85	7.00	7.00	0.00
W-3	14.16	14.59	-0.43	3.00	3.00	0.00
C-1	17.46	14.69	2.71	13.00	0.00	13.00
B-3	14.35	13.24	1.11	10.00	0.00	10.00
B-2	17.08	16.51	0.57	6.00	0.00	6.00

MEAN G: 16.25 STD DEV G: 1.89 SUM OF NEG RANKS: 19.00  
 MEAN H: 14.94 STD DEV H: 1.05 SUM OF POS RANKS: 101.00

THERE IS A 9% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.02$ ).

# WILCOXON COMPARISON G-H

## ANALYSIS OF CHEST RESULTANT ACCELERATION

(IMPACT MAXIMUM)

SUBJ	G CELL VALUE	H CELL VALUE	DIFFERENCE (G - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
E-2	15.32	14.65	0.67	5.00	0.00	5.00
S-6	21.88	13.76	8.12	15.00	0.00	15.00
C-2	15.64	14.54	1.10	10.00	0.00	10.00
M13	15.03	16.13	-1.10	9.00	9.00	0.00
J-4	16.49	16.16	0.33	3.00	0.00	3.00
A-2	16.11	13.79	2.32	12.00	0.00	12.00
P-3	16.51	15.66	0.85	6.00	0.00	6.00
W-4	16.46	16.49	-0.03	1.00	1.00	0.00
B-1	16.43	16.31	0.12	2.00	0.00	2.00
H-6	18.26	14.33	3.93	14.00	0.00	14.00
K-1	15.03	15.93	-0.90	7.00	7.00	0.00
W-3	14.21	14.59	-0.38	4.00	4.00	0.00
C-1	17.59	15.04	2.55	13.00	0.00	13.00
B-3	15.20	13.81	1.39	11.00	0.00	11.00
B-2	17.58	16.58	1.00	8.00	0.00	8.00

MEAN G: 16.52 STD DEV G: 1.85 SUM OF NEG RANKS: 21.00 -----  
 MEAN H: 15.18 STD DEV H: 1.04 SUM OF POS RANKS: ----- 99.00

THERE IS A 9% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.05$ ).

# WILCOXON COMPARISON G-H

## ANALYSIS OF CHEST SEVERITY INDEX

(IMPACT MAXIMUM)

SUBJ	G CELL VALUE	H CELL VALUE	DIFFERENCE (G - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
E-2	29.99	23.21	6.78	15.00	0.00	15.00
S-6	29.55	24.16	5.39	13.00	0.00	13.00
C-2	27.29	28.24	-0.95	3.00	3.00	0.00
M13	28.65	25.67	2.98	9.00	0.00	9.00
J-4	27.67	30.15	-2.48	6.00	6.00	0.00
A-2	31.80	26.94	4.86	12.00	0.00	12.00
P-3	30.63	28.01	2.62	7.00	0.00	7.00
W-4	30.09	29.25	0.84	2.00	0.00	2.00
B-1	30.04	27.87	2.17	5.00	0.00	5.00
H-6	33.09	26.76	6.33	14.00	0.00	14.00
K-1	31.95	30.01	1.94	4.00	0.00	4.00
W-3	28.29	28.73	-0.44	1.00	1.00	0.00
C-1	32.64	27.89	4.75	10.00	0.00	10.00
B-3	27.26	24.60	2.66	8.00	0.00	8.00
B-2	32.49	27.70	4.79	11.00	0.00	11.00

MEAN G: 30.10 STD DEV G: 1.99 SUM OF NEG RANKS: 10.00 -----  
 MEAN H: 27.28 STD DEV H: 2.08 SUM OF POS RANKS: ----- 110.00

THERE IS A 10% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON G-H

## ANALYSIS OF HEAD Z ACCELERATION (G)

(IMPACT MAXIMUM)

SUBJ	G CELL VALUE	H CELL VALUE	DIFFERENCE (G - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
E-2	11.82	10.68	1.14	11.00	0.00	11.00
S-6	11.63	10.81	0.82	10.00	0.00	10.00
C-2	10.95	10.69	0.26	6.50	0.00	6.50
M13	12.04	12.07	-0.03	1.00	1.00	0.00
J-4	12.40	12.45	-0.05	2.00	2.00	0.00
A-2	12.94	12.29	0.65	8.00	0.00	8.00
P-3	12.25	12.10	0.15	4.00	0.00	4.00
W-4	12.24	10.70	1.54	13.00	0.00	13.00
B-1	14.34	14.21	0.13	3.00	0.00	3.00
H-6	11.93	10.09	1.84	14.00	0.00	14.00
K-1	13.23	12.49	0.74	9.00	0.00	9.00
W-3	11.02	11.22	-0.20	5.00	5.00	0.00
C-1	12.89	11.49	1.40	12.00	0.00	12.00
B-3	12.04	11.78	0.26	6.50	0.00	6.50
B-2	13.29	11.35	1.94	15.00	0.00	15.00

MEAN G: 12.33 STD DEV G: 0.89 SUM OF NEG RANKS: 8.00 -----  
 MEAN H: 11.63 STD DEV H: 1.03 SUM OF POS RANKS: ----- 112.00

THERE IS A 6% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON G-H

## ANALYSIS OF HEAD RESULTANT ACCELERATION

(IMPACT MAXIMUM)

SUBJ	G CELL VALUE	H CELL VALUE	DIFFERENCE (G - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
E-2	12.21	11.27	0.94	10.00	0.00	10.00
S-6	12.55	10.95	1.60	12.00	0.00	12.00
C-2	11.14	11.02	0.12	3.00	0.00	3.00
M13	12.22	12.50	-0.28	5.00	5.00	0.00
J-4	12.92	13.05	-0.13	4.00	4.00	0.00
A-2	13.02	12.32	0.70	9.00	0.00	9.00
P-3	12.56	12.22	0.34	6.00	0.00	6.00
W-4	13.01	11.51	1.50	11.00	0.00	11.00
B-1	14.37	14.27	0.10	2.00	0.00	2.00
H-6	13.03	11.04	1.99	15.00	0.00	15.00
K-1	13.28	12.63	0.65	7.50	0.00	7.50
W-3	11.20	11.24	-0.04	1.00	1.00	0.00
C-1	13.70	11.99	1.71	13.00	0.00	13.00
B-3	12.70	12.05	0.65	7.50	0.00	7.50
B-2	13.79	11.97	1.82	14.00	0.00	14.00

MEAN G: 12.78 STD DEV G: 0.88 SUM OF NEG RANKS: 10.00 -----  
 MEAN H: 12.00 STD DEV H: 0.90 SUM OF POS RANKS: ----- 110.00

THERE IS A 7% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON G-H

## ANALYSIS OF HEAD SEVERITY INDEX

(IMPACT MAXIMUM)

SUBJ	G CELL VALUE	H CELL VALUE	DIFFERENCE (G - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
E-2	20.43	18.39	2.04	9.00	0.00	9.00
S-6	20.79	17.17	3.62	12.00	0.00	12.00
C-2	21.07	19.79	1.28	5.00	0.00	5.00
M13	21.12	19.52	1.60	7.00	0.00	7.00
J-4	24.05	24.10	-0.04	1.00	1.00	0.00
A-2	22.39	21.13	1.26	4.00	0.00	4.00
P-3	22.26	22.01	0.25	2.00	0.00	2.00
W-4	20.55	18.18	2.38	11.00	0.00	11.00
B-1	23.84	22.02	1.82	8.00	0.00	8.00
H-6	25.03	19.32	5.71	14.00	0.00	14.00
K-1	23.69	19.92	3.77	13.00	0.00	13.00
W-3	22.32	21.65	0.67	3.00	0.00	3.00
C-1	34.51	20.22	14.29	15.00	0.00	15.00
B-3	21.50	19.92	1.58	6.00	0.00	6.00
B-2	22.07	19.72	2.35	10.00	0.00	10.00

MEAN G: 23.04 STD DEV G: 3.46 SUM OF NEG RANKS: 1.00 -----  
 MEAN H: 20.20 STD DEV H: 1.75 SUM OF POS RANKS: ----- 119.00

THERE IS A 14% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON G-H

## ANALYSIS OF TOTAL SHOULDER STRAP LOAD (LB)

(FREEFALL MAXIMUM)

SUBJ	G CELL VALUE	H CELL VALUE	DIFFERENCE (G - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
E-2	110.06	203.78	-93.72	15.00	15.00	0.00
S-6	45.84	74.08	-28.24	6.00	6.00	0.00
C-2	58.79	75.92	-17.13	4.00	4.00	0.00
M13	75.23	116.51	-41.28	9.00	9.00	0.00
J-4	126.67	136.44	-9.77	3.00	3.00	0.00
A-2	68.85	76.40	-7.55	1.00	1.00	0.00
P-3	151.60	182.10	-30.50	8.00	8.00	0.00
W-4	90.16	97.84	-7.68	2.00	2.00	0.00
B-1	62.35	89.95	-27.60	5.00	5.00	0.00
H-6	97.43	171.78	-74.35	14.00	14.00	0.00
K-1	101.32	150.62	-49.30	10.00	10.00	0.00
W-3	93.58	162.45	-68.87	13.00	13.00	0.00
C-1	140.93	203.67	-62.74	11.00	11.00	0.00
B-3	108.14	137.21	-29.07	7.00	7.00	0.00
B-2	71.23	134.56	-63.33	12.00	12.00	0.00

MEAN G: 93.48 STD DEV G: 30.69 SUM OF NEG RANKS: 120.00 -----  
 MEAN H: 134.22 STD DEV H: 45.04 SUM OF POS RANKS: ----- 0.00

THERE IS A 44% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON G-H

## ANALYSIS OF TOTAL SHOULDER STRAP LOAD (LB)

(IMPACT MAXIMUM MINUS FREEFALL MAXIMUM)

### DATA

CONDITION G			CONDITION H		
SUBJ	FREEFALL MAXIMUM	IMPACT MAXIMUM	SUBJ	FREEFALL MAXIMUM	IMPACT MAXIMUM
E-2	110.06	253.29	E-2	203.78	319.34
S-6	45.84	148.70	S-6	74.08	153.31
C-2	58.79	190.63	C-2	75.92	193.41
M13	75.23	125.59	M13	116.51	143.88
J-4	126.67	157.03	J-4	136.44	149.39
A-2	68.85	134.04	A-2	76.40	118.14
P-3	151.60	264.03	P-3	182.10	204.56
W-4	90.16	161.31	W-4	97.84	169.85
B-1	62.35	80.20	B-1	89.95	94.78
H-6	97.43	201.98	H-6	171.78	240.12
K-1	101.32	153.47	K-1	150.62	138.51
W-3	93.58	164.30	W-3	162.45	219.15
C-1	140.93	201.22	C-1	203.67	187.10
B-3	108.14	154.94	B-3	137.21	112.07
B-2	71.23	114.89	B-2	134.56	136.93

### ANALYSIS

SUBJ	G CELL VALUE	H CELL VALUE	DIFFERENCE (G - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
E-2	143.23	115.56	27.67	9.00	0.00	9.00
S-6	102.86	79.23	23.63	8.00	0.00	8.00
C-2	131.84	117.49	14.35	4.00	0.00	4.00
M13	50.36	27.37	22.99	6.00	0.00	6.00
J-4	30.36	12.95	17.41	5.00	0.00	5.00
A-2	65.19	41.74	23.45	7.00	0.00	7.00
P-3	112.43	22.46	89.97	15.00	0.00	15.00
W-4	71.15	72.01	-0.86	1.00	1.00	0.00
B-1	17.85	4.83	13.02	2.00	0.00	2.00
H-6	104.55	68.34	36.21	10.00	0.00	10.00
K-1	52.15	-12.11	64.26	12.00	0.00	12.00
W-3	70.72	56.70	14.02	3.00	0.00	3.00
C-1	60.29	-16.57	76.86	14.00	0.00	14.00
B-3	46.80	-25.14	71.94	13.00	0.00	13.00
B-2	43.66	2.37	41.29	11.00	0.00	11.00

MEAN G: 73.56 STD DEV G: 37.24 SUM OF NEG RANKS: 1.00  
 MEAN H: 37.82 STD DEV H: 45.75 SUM OF POS RANKS: 119.00

THERE IS A 95% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).



# WILCOXON COMPARISON G-H

## ANALYSIS OF TOTAL LAP BELT LOAD (LB)

(IMPACT MAXIMUM MINUS IMPACT MINIMUM)

### DATA

CONDITION G			CONDITION H		
SUBJ	IMPACT MINIMUM	IMPACT MAXIMUM	SUBJ	IMPACT MINIMUM	IMPACT MAXIMUM
E-2	163.62	304.86	E-2	194.86	317.32
S-6	157.97	259.34	S-6	151.44	241.54
C-2	163.93	327.38	C-2	159.53	254.58
M13	140.37	229.01	M13	285.10	343.82
J-4	73.08	208.03	J-4	165.67	274.07
A-2	83.03	200.94	A-2	178.40	242.98
P-3	245.18	374.74	P-3	230.07	310.87
W-4	119.97	321.02	W-4	144.85	232.37
B-1	118.55	187.75	B-1	145.10	206.77
H-6	73.18	268.56	H-6	183.00	318.89
K-1	188.47	329.18	K-1	111.16	187.70
W-3	68.58	161.28	W-3	65.99	150.35
C-1	205.61	338.30	C-1	226.70	297.44
B-3	152.17	253.97	B-3	225.37	314.96
B-2	118.75	191.60	B-2	100.60	149.58

### ANALYSIS

SUBJ	G CELL VALUE	H CELL VALUE	DIFFERENCE (G - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
E-2	141.24	122.46	18.78	5.00	0.00	5.00
S-6	101.37	90.10	11.27	3.00	0.00	3.00
C-2	163.45	95.05	68.40	14.00	0.00	14.00
M13	88.64	58.72	29.92	8.00	0.00	8.00
J-4	134.95	108.40	26.55	7.00	0.00	7.00
A-2	117.91	64.58	53.33	10.00	0.00	10.00
P-3	129.56	80.80	48.76	9.00	0.00	9.00
W-4	201.05	87.52	113.53	15.00	0.00	15.00
B-1	69.20	61.67	7.53	1.00	0.00	1.00
H-6	195.38	135.89	59.49	11.00	0.00	11.00
K-1	140.71	76.54	64.17	13.00	0.00	13.00
W-3	92.70	84.36	8.34	2.00	0.00	2.00
C-1	132.69	70.74	61.95	12.00	0.00	12.00
B-3	101.80	89.59	12.21	4.00	0.00	4.00
B-2	72.85	48.98	23.87	6.00	0.00	6.00

MEAN G: 125.57 STD DEV G: 39.86 SUM OF NEG RANKS: 0.00  
 MEAN H: 85.03 STD DEV H: 23.81 SUM OF POS RANKS: 120.00

THERE IS A 48% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON G-H

## ANALYSIS OF VERTICAL SEAT LOAD (LB)

(FREEFALL MAXIMUM)

SUBJ	G CELL VALUE	H CELL VALUE	DIFFERENCE (G - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
E-2	219.62	484.18	-264.56	14.00	14.00	0.00
S-6	131.29	212.31	-81.02	3.00	3.00	0.00
C-2	200.02	286.10	-86.08	5.00	5.00	0.00
M13	252.54	404.38	-151.84	11.00	11.00	0.00
J-4	361.25	418.47	-57.22	1.00	1.00	0.00
A-2	241.59	310.47	-68.88	2.00	2.00	0.00
P-3	403.40	525.11	-121.71	9.00	9.00	0.00
M-4	317.75	408.54	-90.79	6.00	6.00	0.00
B-1	187.65	292.72	-105.07	8.00	8.00	0.00
H-6	222.70	504.73	-282.03	15.00	15.00	0.00
K-1	346.63	431.52	-84.89	4.00	4.00	0.00
M-3	217.36	321.83	-104.47	7.00	7.00	0.00
C-1	400.67	597.40	-196.73	12.00	12.00	0.00
B-3	308.56	518.15	-209.59	13.00	13.00	0.00
B-2	244.25	388.58	-144.33	10.00	10.00	0.00

MEAN G: 270.35 STD DEV G: 81.54 SUM OF NEG RANKS: 120.00  
 MEAN H: 406.97 STD DEV H: 107.34 SUM OF POS RANKS: 0.00

THERE IS A 51% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON G-H

## ANALYSIS OF RESULTANT SEAT LOAD (LB)

(FREEFALL MAXIMUM)

SUBJ	G CELL VALUE	H CELL VALUE	DIFFERENCE (G - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
E-2	219.77	486.30	-266.53	14.00	14.00	0.00
S-6	131.43	213.95	-82.52	3.00	3.00	0.00
C-2	200.52	287.17	-86.65	5.00	5.00	0.00
M13	253.43	409.24	-155.81	11.00	11.00	0.00
J-4	361.53	418.61	-57.08	1.00	1.00	0.00
A-2	241.62	311.01	-69.39	2.00	2.00	0.00
P-3	404.25	525.63	-121.38	9.00	9.00	0.00
M-4	318.04	409.12	-91.08	6.00	6.00	0.00
B-1	188.60	293.52	-104.92	8.00	8.00	0.00
H-6	222.82	505.73	-282.91	15.00	15.00	0.00
K-1	346.94	432.61	-85.67	4.00	4.00	0.00
M-3	226.72	324.34	-97.62	7.00	7.00	0.00
C-1	403.62	599.87	-196.25	12.00	12.00	0.00
B-3	312.08	518.37	-206.29	13.00	13.00	0.00
B-2	244.68	388.74	-144.05	10.00	10.00	0.00

MEAN G: 271.74 STD DEV G: 81.59 SUM OF NEG RANKS: 120.00  
 MEAN H: 408.28 STD DEV H: 107.36 SUM OF POS RANKS: 0.00

THERE IS A 50% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON G-H

ANALYSIS OF VERTICAL SEAT LOAD (LB)  
(IMPACT MAXIMUM MINUS FREEFALL MAXIMUM)

DATA

CONDITION G			CONDITION H		
SUBJ	FREEFALL MAXIMUM	IMPACT MAXIMUM	SUBJ	FREEFALL MAXIMUM	IMPACT MAXIMUM
E-2	219.62	2102.87	E-2	484.18	1966.45
S-6	131.29	1429.27	S-6	212.31	1477.75
C-2	200.02	2126.11	C-2	286.10	2148.73
M13	252.54	2151.35	M13	404.38	2113.67
J-4	361.25	2265.30	J-4	418.47	2557.92
A-2	241.59	2049.51	A-2	310.47	1957.14
P-3	403.40	2557.40	P-3	525.11	2672.47
W-4	317.75	2219.53	W-4	408.54	2244.50
B-1	187.65	1972.80	B-1	292.72	1924.38
H-6	222.70	2172.74	H-6	504.73	2259.57
K-1	346.63	2359.21	K-1	431.52	2319.19
W-3	217.36	2142.00	W-3	321.83	2059.74
C-1	400.67	2168.48	C-1	597.40	2269.51
B-3	308.56	2093.90	B-3	518.15	2330.34
B-2	244.25	2584.19	B-2	388.58	2456.90

## ANALYSIS

SUBJ	G CELL VALUE	H CELL VALUE	DIFFERENCE (G - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
E-2	1883.25	1482.27	400.98	15.00	0.00	15.00
S-6	1297.98	1265.44	32.54	3.00	0.00	3.00
C-2	1926.09	1862.63	63.46	4.00	0.00	4.00
M13	1898.81	1709.29	189.52	11.00	0.00	11.00
J-4	1904.05	2139.45	-235.40	13.00	13.00	0.00
A-2	1807.92	1646.67	161.25	9.00	0.00	9.00
P-3	2154.00	2147.36	6.64	1.00	0.00	1.00
W-4	1901.78	1835.96	65.82	5.00	0.00	5.00
B-1	1785.15	1631.66	153.49	8.00	0.00	8.00
H-6	1950.04	1754.84	195.20	12.00	0.00	12.00
K-1	2012.58	1887.67	124.91	7.00	0.00	7.00
W-3	1924.64	1737.91	186.73	10.00	0.00	10.00
C-1	1767.81	1672.11	95.70	6.00	0.00	6.00
B-3	1785.34	1812.19	-26.85	2.00	2.00	0.00
B-2	2339.94	2068.32	271.62	14.00	0.00	14.00

MEAN G: 1889.29 STD DEV G: 221.65 SUM OF NEG RANKS: 15.00  
MEAN H: 1776.42 STD DEV H: 236.34 SUM OF POS RANKS: 105.00

THERE IS A 6% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON G-H

## ANALYSIS OF RESULTANT SEAT LOAD (LB)

(IMPACT MAXIMUM MINUS FREEFALL MAXIMUM)

### DATA

CONDITION G			CONDITION H		
SUBJ	FREEFALL MAXIMUM	IMPACT MAXIMUM	SUBJ	FREEFALL MAXIMUM	IMPACT MAXIMUM
E-2	219.77	2104.48	E-2	486.30	1968.16
S-6	131.43	1429.98	S-6	213.95	1477.82
C-2	200.52	2126.79	C-2	287.17	2149.74
M13	253.43	2151.50	M13	409.24	2115.78
J-4	361.53	2265.82	J-4	418.61	2558.23
A-2	241.62	2049.77	A-2	311.01	1958.04
P-3	404.25	2559.97	P-3	525.63	2673.33
W-4	318.04	2219.70	W-4	409.12	2245.18
B-1	188.60	1974.40	B-1	293.52	1925.48
H-6	222.82	2174.33	H-6	505.73	2259.65
K-1	346.94	2360.59	K-1	432.61	2320.32
W-3	226.72	2142.18	W-3	324.34	2060.55
C-1	403.62	2168.66	C-1	599.87	2269.66
B-3	312.08	2096.53	B-3	518.37	2330.56
B-2	244.69	2584.93	B-2	388.74	2456.90

### ANALYSIS

SUBJ	G CELL VALUE	H CELL VALUE	DIFFERENCE (G - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
E-2	1884.71	1481.86	402.85	15.00	0.00	15.00
S-6	1298.55	1263.87	34.68	3.00	0.00	3.00
C-2	1926.27	1862.57	63.70	4.00	0.00	4.00
M13	1898.07	1706.54	191.53	11.00	0.00	11.00
J-4	1904.29	2139.62	-235.33	13.00	13.00	0.00
A-2	1808.15	1647.03	161.12	9.00	0.00	9.00
P-3	2155.72	2147.70	8.02	1.00	0.00	1.00
W-4	1901.66	1836.06	65.60	5.00	0.00	5.00
B-1	1785.80	1631.98	153.84	8.00	0.00	8.00
H-6	1951.51	1753.92	197.59	12.00	0.00	12.00
K-1	2013.65	1887.71	125.94	7.00	0.00	7.00
W-3	1915.46	1736.21	179.25	10.00	0.00	10.00
C-1	1765.04	1669.79	95.25	6.00	0.00	6.00
B-3	1784.45	1812.19	-27.74	2.00	2.00	0.00
B-2	2340.24	2068.16	272.08	14.00	0.00	14.00

MEAN G: 1888.90    STO DEV G: 221.83    SUM OF NEG RANKS: 15.00    -----  
 MEAN H: 1776.35    STO DEV H: 236.79    SUM OF POS RANKS: -----    105.00

THERE IS A 6% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON E-G

## ANALYSIS OF CARRIAGE ACCELERATION (G)

(IMPACT MAXIMUM)

SUBJ	E CELL VALUE	G CELL VALUE	DIFFERENCE (E - G)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
H-6	9.94	9.94	0.00	0.00	0.00	0.00
B-1	9.97	9.92	0.05	5.00	0.00	5.00
P-3	9.92	9.90	0.02	3.50	0.00	3.50
W-4	9.90	9.92	-0.02	3.50	3.50	0.00
C-2	9.90	10.01	-0.11	8.50	8.50	0.00
B-3	9.90	10.02	-0.12	11.00	11.00	0.00
M13	9.90	10.01	-0.11	8.50	8.50	0.00
J-4	9.94	9.95	-0.01	1.50	1.50	0.00
W-3	9.94	9.95	-0.01	1.50	1.50	0.00
K-1	9.83	9.95	-0.12	10.00	10.00	0.00
S-6	10.06	10.06	0.00	0.00	0.00	0.00
A-2	9.94	9.94	0.00	0.00	0.00	0.00
B-2	9.91	9.97	-0.06	6.00	6.00	0.00
C-1	9.89	9.96	-0.07	7.00	7.00	0.00

MEAN E: 9.92 STD DEV E: 0.05 SUM OF NEG RANKS: 57.50  
 MEAN G: 9.96 STD DEV G: 0.05 SUM OF POS RANKS: 8.50

THERE IS A 0.4% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.05$ ).

# WILCOXON COMPARISON E-G

## ANALYSIS OF CHEST Z ACCELERATION (G)

(IMPACT MAXIMUM)

SUBJ	E CELL VALUE	G CELL VALUE	DIFFERENCE (E - G)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
H-6	21.33	17.85	3.48	5.00	0.00	5.00
B-1	19.85	16.25	3.60	6.00	0.00	6.00
P-3	16.35	16.16	0.19	1.00	0.00	1.00
W-4	22.33	16.29	6.04	12.00	0.00	12.00
C-2	18.73	15.48	3.25	4.00	0.00	4.00
B-3	20.41	14.35	6.06	13.00	0.00	13.00
M13	20.15	14.88	5.27	10.00	0.00	10.00
J-4	19.01	16.44	2.57	3.00	0.00	3.00
W-3	18.75	14.16	4.59	8.00	0.00	8.00
K-1	19.86	14.64	5.22	9.00	0.00	9.00
S-6	15.84	21.82	-5.98	11.00	11.00	0.00
A-2	20.03	15.90	4.13	7.00	0.00	7.00
B-2	24.60	17.08	7.52	14.00	0.00	14.00
C-1	18.20	17.40	0.80	2.00	0.00	2.00

MEAN E: 19.67 STD DEV E: 2.24 SUM OF NEG RANKS: 11.00  
 MEAN G: 16.34 STD DEV G: 1.94 SUM OF POS RANKS: 94.00

THERE IS A 21% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON E-G

## ANALYSIS OF CHEST RESULTANT ACCELERATION

(IMPACT MAXIMUM)

SUBJ	E CELL VALUE	G CELL VALUE	DIFFERENCE (E - G)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
H-6	21.53	18.26	3.27	4.00	0.00	4.00
B-1	20.46	16.43	4.03	6.00	0.00	6.00
P-3	17.38	16.51	0.87	2.00	0.00	2.00
W-4	22.40	16.46	5.94	13.00	0.00	13.00
C-2	18.94	15.64	3.30	5.00	0.00	5.00
B-3	20.56	15.20	5.36	11.00	0.00	11.00
M13	20.15	15.03	5.12	9.00	0.00	9.00
J-4	19.05	16.49	2.56	3.00	0.00	3.00
W-3	18.84	14.21	4.63	8.00	0.00	8.00
K-1	20.22	15.03	5.19	10.00	0.00	10.00
S-6	16.18	21.88	-5.70	12.00	12.00	0.00
A-2	20.15	16.11	4.04	7.00	0.00	7.00
B-2	24.74	17.58	7.16	14.00	0.00	14.00
C-1	18.26	17.59	0.67	1.00	0.00	1.00

MEAN E: 19.92 STD DEV E: 2.13 SUM OF NEG RANKS: 12.00  
 MEAN G: 16.60 STD DEV G: 1.89 SUM OF POS RANKS: 93.00

THERE IS A 20% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON E-G

## ANALYSIS OF CHEST SEVERITY INDEX

(IMPACT MAXIMUM)

SUBJ	E CELL VALUE	G CELL VALUE	DIFFERENCE (E - G)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
H-6	43.52	33.09	10.43	10.00	0.00	10.00
B-1	37.98	30.04	7.94	6.00	0.00	6.00
P-3	32.68	30.63	2.05	3.00	0.00	3.00
W-4	41.57	30.09	11.48	13.00	0.00	13.00
C-2	33.84	27.29	6.55	5.00	0.00	5.00
B-3	36.20	27.26	8.94	9.00	0.00	9.00
M13	40.06	28.65	11.41	12.00	0.00	12.00
J-4	35.72	27.67	8.05	7.00	0.00	7.00
W-3	38.83	28.29	10.54	11.00	0.00	11.00
K-1	40.61	31.95	8.66	8.00	0.00	8.00
S-6	30.07	29.55	0.52	1.00	0.00	1.00
A-2	34.78	31.80	2.98	4.00	0.00	4.00
B-2	46.13	32.49	13.64	14.00	0.00	14.00
C-1	34.34	32.64	1.70	2.00	0.00	2.00

MEAN E: 37.60 STD DEV E: 4.47 SUM OF NEG RANKS: 0.00  
 MEAN G: 30.10 STD DEV G: 2.06 SUM OF POS RANKS: 105.00

THERE IS A 25% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON E-G

## ANALYSIS OF TOTAL SHOULDER STRAP LOAD (LB)

(FREEFALL MAXIMUM)

SUBJ	E CELL VALUE	G CELL VALUE	DIFFERENCE (E - G)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
H-6	93.37	97.43	-4.06	1.00	1.00	0.00
B-1	40.54	62.35	-21.81	7.00	7.00	0.00
P-3	78.10	151.60	-73.50	14.00	14.00	0.00
W-4	60.75	90.16	-29.41	8.00	8.00	0.00
C-2	42.34	58.79	-16.45	4.00	4.00	0.00
B-3	90.61	108.14	-17.53	5.00	5.00	0.00
M13	34.67	75.23	-40.56	10.00	10.00	0.00
J-4	59.66	126.67	-67.01	13.00	13.00	0.00
W-3	52.33	93.58	-41.25	11.00	11.00	0.00
K-1	68.25	101.32	-33.07	9.00	9.00	0.00
S-6	40.37	45.84	-5.47	2.00	2.00	0.00
A-2	54.24	68.85	-14.61	3.00	3.00	0.00
B-2	90.62	71.23	19.39	6.00	0.00	6.00
C-1	90.13	140.93	-50.80	12.00	12.00	0.00

MEAN E: 64.00 STD DEV E: 21.26 SUM OF NEG RANKS: 99.00 -----  
 MEAN G: 92.29 STD DEV G: 31.49 SUM OF POS RANKS: ----- 6.00

THERE IS A 44% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON E-G

## ANALYSIS OF TOTAL LAP BELT LOAD (LB)

(FREEFALL MAXIMUM)

SUBJ	E CELL VALUE	G CELL VALUE	DIFFERENCE (E - G)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
H-6	222.15	241.99	-19.84	3.00	3.00	0.00
B-1	250.77	235.06	15.71	2.00	0.00	2.00
P-3	360.34	501.90	-141.56	13.00	13.00	0.00
W-4	285.64	368.56	-82.92	10.00	10.00	0.00
C-2	175.56	244.11	-68.55	8.00	8.00	0.00
B-3	342.79	378.73	-35.94	6.00	6.00	0.00
M13	233.87	268.13	-34.26	5.00	5.00	0.00
J-4	286.68	377.86	-91.18	11.00	11.00	0.00
W-3	196.40	216.32	-19.92	4.00	4.00	0.00
K-1	239.94	397.69	-157.75	14.00	14.00	0.00
S-6	148.73	224.88	-76.15	9.00	9.00	0.00
A-2	230.43	273.01	-42.58	7.00	7.00	0.00
B-2	251.26	243.22	8.04	1.00	0.00	1.00
C-1	362.60	480.34	-117.74	12.00	12.00	0.00

MEAN E: 256.23 STD DEV E: 65.47 SUM OF NEG RANKS: 102.00 -----  
 MEAN G: 317.99 STD DEV G: 97.50 SUM OF POS RANKS: ----- 3.00

THERE IS A 24% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON E-G

ANALYSIS OF TOTAL SHOULDER STRAP LOAD (LB)

(IMPACT MAXIMUM MINUS FREEFALL MAXIMUM)

## DATA

CONDITION E			CONDITION G		
SUBJ	FREEFALL MAXIMUM	IMPACT MAXIMUM	SUBJ	FREEFALL MAXIMUM	IMPACT MAXIMUM
H-6	93.37	249.11	H-6	97.43	201.98
B-1	40.54	86.91	B-1	62.35	80.20
P-3	78.10	223.43	P-3	151.60	264.03
W-4	60.75	204.59	W-4	90.16	161.31
C-2	42.34	164.71	C-2	58.79	190.63
B-3	90.61	155.60	B-3	108.14	154.94
M13	34.67	117.08	M13	75.23	125.59
J-4	59.66	156.34	J-4	126.67	157.03
W-3	52.33	164.28	W-3	93.58	164.30
K-1	68.25	165.96	K-1	101.32	153.47
S-6	40.37	147.36	S-6	45.84	148.70
A-2	54.24	131.87	A-2	68.85	134.04
B-2	90.62	197.93	B-2	71.23	114.89
C-1	90.13	207.91	C-1	140.93	201.22

## ANALYSIS

SUBJ	E CELL VALUE	G CELL VALUE	DIFFERENCE (E - G)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
H-6	155.74	104.55	51.19	10.00	0.00	10.00
B-1	46.37	17.85	28.52	5.00	0.00	5.00
P-3	145.33	112.43	32.90	7.00	0.00	7.00
W-4	143.84	71.15	72.69	14.00	0.00	14.00
C-2	122.37	131.84	-9.47	2.00	2.00	0.00
B-3	64.99	46.80	18.19	4.00	0.00	4.00
M13	82.41	50.36	32.05	6.00	0.00	6.00
J-4	96.68	30.36	66.32	13.00	0.00	13.00
W-3	111.95	70.72	41.23	8.00	0.00	8.00
K-1	97.71	52.15	45.56	9.00	0.00	9.00
S-6	106.99	102.86	4.13	1.00	0.00	1.00
A-2	77.63	65.19	12.44	3.00	0.00	3.00
B-2	107.31	43.66	63.65	12.00	0.00	12.00
C-1	117.78	60.29	57.49	11.00	0.00	11.00

MEAN E: 105.51 STD DEV E: 31.19 SUM OF NEG RANKS: 2.00  
 MEAN G: 68.59 STD DEV G: 33.07 SUM OF POS RANKS: 103.00

THERE IS A 54% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).



# WILCOXON COMPARISON E-G

## ANALYSIS OF VERTICAL SEAT LOAD (LB)

(FREEFALL MAXIMUM)

SUBJ	E CELL VALUE	G CELL VALUE	DIFFERENCE (E - G)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
H-6	212.86	222.70	-9.84	5.00	5.00	0.00
B-1	184.49	187.65	-3.16	4.00	4.00	0.00
P-3	333.25	403.40	-70.15	10.00	10.00	0.00
W-4	244.02	317.75	-73.73	11.00	11.00	0.00
C-2	202.18	200.02	2.16	2.00	0.00	2.00
B-3	274.26	308.56	-34.30	9.00	9.00	0.00
M13	266.32	252.54	13.78	7.00	0.00	7.00
J-4	283.01	361.25	-78.24	12.00	12.00	0.00
W-3	230.88	217.36	13.52	6.00	0.00	6.00
K-1	238.22	346.63	-108.41	14.00	14.00	0.00
S-6	128.98	131.29	-2.31	3.00	3.00	0.00
A-2	219.72	241.59	-21.87	8.00	8.00	0.00
B-2	242.51	244.25	-1.74	1.00	1.00	0.00
C-1	302.13	400.67	-98.54	13.00	13.00	0.00

MEAN E: 240.20 STD DEV E: 51.41 SUM OF NEG RANKS: 90.00 -----  
 MEAN G: 273.98 STD DEV G: 83.35 SUM OF POS RANKS: ----- 15.00

THERE IS A 14% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.02$ ).

# WILCOXON COMPARISON E-G

## ANALYSIS OF RESULTANT SEAT LOAD (LB)

(FREEFALL MAXIMUM)

SUBJ	E CELL VALUE	G CELL VALUE	DIFFERENCE (E - G)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
H-6	212.92	222.82	-9.90	5.00	5.00	0.00
B-1	184.67	188.60	-3.93	3.00	3.00	0.00
P-3	333.59	404.25	-70.66	10.00	10.00	0.00
W-4	244.82	318.04	-73.22	11.00	11.00	0.00
C-2	202.21	200.52	1.69	1.00	0.00	1.00
B-3	279.05	312.08	-33.03	9.00	9.00	0.00
M13	278.93	253.43	25.50	8.00	0.00	8.00
J-4	285.19	361.53	-76.34	12.00	12.00	0.00
W-3	243.77	226.72	17.05	6.00	0.00	6.00
K-1	238.30	346.94	-108.64	14.00	14.00	0.00
S-6	128.98	131.43	-2.45	2.00	2.00	0.00
A-2	219.83	241.62	-21.79	7.00	7.00	0.00
B-2	248.96	244.69	4.27	4.00	0.00	4.00
C-1	305.21	403.62	-98.41	13.00	13.00	0.00

MEAN E: 243.32 STD DEV E: 52.63 SUM OF NEG RANKS: 86.00 -----  
 MEAN G: 275.45 STD DEV G: 83.35 SUM OF POS RANKS: ----- 19.00

THERE IS A 13% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.05$ ).

# WILCOXON COMPARISON E-G

## ANALYSIS OF HORIZONTAL SEAT LOAD (LB)

(IMPACT MINIMUM MINUS FREEFALL MAXIMUM)

### DATA

CONDITION E			CONDITION G		
SUBJ	FREEFALL MAXIMUM	IMPACT MINIMUM	SUBJ	FREEFALL MAXIMUM	IMPACT MINIMUM
H-6	7.20	-74.34	H-6	-0.11	-57.75
B-1	-0.61	-59.59	B-1	13.85	-45.20
P-3	-1.26	-68.36	P-3	0.99	-75.42
W-4	1.71	-86.33	W-4	0.49	-22.66
C-2	4.93	-72.11	C-2	-0.16	-55.36
B-3	75.90	-18.69	B-3	62.00	-19.43
M13	70.72	1.19	M13	23.30	-33.46
J-4	38.44	-28.91	J-4	3.23	-51.70
W-3	20.29	-68.99	W-3	20.95	-39.50
K-1	5.82	-61.32	K-1	0.66	-53.56
S-6	23.48	-12.93	S-6	2.84	-32.45
A-2	7.32	-14.47	A-2	2.41	-11.10
B-2	26.46	-72.73	B-2	-2.60	-98.75
C-1	36.18	-35.65	C-1	79.25	-18.42

### ANALYSIS

SUBJ	E CELL VALUE	G CELL VALUE	DIFFERENCE (E - G)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
H-6	-81.54	-57.64	-23.90	11.00	11.00	0.00
B-1	-58.98	-59.05	0.07	1.00	0.00	1.00
P-3	-67.10	-76.41	9.31	5.00	0.00	5.00
W-4	-88.04	-23.15	-64.89	14.00	14.00	0.00
C-2	-77.04	-55.20	-21.84	10.00	10.00	0.00
B-3	-94.59	-81.43	-13.16	9.00	9.00	0.00
M13	-69.53	-56.76	-12.77	7.00	7.00	0.00
J-4	-67.35	-54.93	-12.42	6.00	6.00	0.00
W-3	-89.28	-60.45	-28.83	13.00	13.00	0.00
K-1	-67.14	-54.22	-12.92	8.00	8.00	0.00
S-6	-36.41	-35.29	-1.12	2.00	2.00	0.00
A-2	-21.79	-13.51	-8.28	4.00	4.00	0.00
B-2	-99.19	-96.15	-3.04	3.00	3.00	0.00
C-1	-71.83	-97.67	25.84	12.00	0.00	12.00

MEAN E: -70.70 STD DEV E: 21.36 SUM OF NEG RANKS: 87.00  
 MEAN G: -58.70 STD DEV G: 24.27 SUM OF POS RANKS: 18.00

THERE IS A 20% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.05$ ).

# WILCOXON COMPARISON E-G

## ANALYSIS OF VERTICAL SEAT LOAD (LB)

(IMPACT MAXIMUM MINUS FREEFALL MAXIMUM)

### DATA

CONDITION E			CONDITION G		
SUBJ	FREEFALL MAXIMUM	IMPACT MAXIMUM	SUBJ	FREEFALL MAXIMUM	IMPACT MAXIMUM
H-6	212.86	2242.47	H-6	222.70	2172.74
B-1	184.49	2073.44	B-1	187.65	1972.80
P-3	333.25	2671.02	P-3	403.40	2557.40
W-4	244.02	2409.89	W-4	317.75	2219.53
C-2	202.18	2278.64	C-2	200.02	2126.11
B-3	274.26	2359.28	B-3	308.56	2093.90
M13	266.32	2396.51	M13	252.54	2151.35
J-4	283.01	2547.80	J-4	361.25	2265.30
W-3	230.88	2218.02	W-3	217.36	2142.00
K-1	238.22	2435.98	K-1	346.63	2359.21
S-6	128.98	1525.85	S-6	131.29	1429.27
A-2	219.72	2055.62	A-2	241.59	2049.51
B-2	242.51	2654.17	B-2	244.25	2584.19
C-1	302.13	2255.03	C-1	400.67	2168.48

### ANALYSIS

SUBJ	E CELL VALUE	G CELL VALUE	DIFFERENCE (E - G)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
H-6	2029.61	1950.04	79.57	4.00	0.00	4.00
B-1	1888.95	1785.15	103.80	6.00	0.00	6.00
P-3	2337.77	2154.00	183.77	8.00	0.00	8.00
W-4	2165.87	1901.78	264.09	12.00	0.00	12.00
C-2	2076.46	1926.09	150.37	7.00	0.00	7.00
B-3	2085.02	1785.34	299.68	13.00	0.00	13.00
M13	2130.19	1898.81	231.38	11.00	0.00	11.00
J-4	2264.79	1904.05	360.74	14.00	0.00	14.00
W-3	1987.14	1924.64	62.50	2.00	0.00	2.00
K-1	2197.76	2012.58	185.18	10.00	0.00	10.00
S-6	1396.87	1297.98	98.89	5.00	0.00	5.00
A-2	1835.90	1807.92	27.98	1.00	0.00	1.00
B-2	2411.66	2339.94	71.72	3.00	0.00	3.00
C-1	1952.90	1767.81	185.09	9.00	0.00	9.00

MEAN E: 2054.35    STD DEV E: 250.42    SUM OF NEG RANKS: 0.00    -----  
 MEAN G: 1889.72    STD DEV G: 230.02    SUM OF POS RANKS: -----    105.00

THERE IS A 8% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON E-G

ANALYSIS OF RESULTANT SEAT LOAD (LB)

(IMPACT MAXIMUM MINUS FREEFALL MAXIMUM)

DATA

CONDITION E			CONDITION G		
SUBJ	FREEFALL MAXIMUM	IMPACT MAXIMUM	SUBJ	FREEFALL MAXIMUM	IMPACT MAXIMUM
H-6	212.92	2243.68	H-6	222.82	2174.33
B-1	184.67	2074.90	B-1	188.60	1974.40
P-3	333.59	2672.54	P-3	404.25	2559.97
W-4	244.82	2411.76	W-4	318.04	2219.70
C-2	202.21	2279.91	C-2	200.52	2126.79
B-3	279.05	2360.87	B-3	312.08	2096.53
M13	278.93	2396.52	M13	253.43	2151.50
J-4	285.19	2548.56	J-4	361.53	2265.82
W-3	243.77	2218.85	W-3	226.72	2142.18
K-1	238.30	2436.76	K-1	346.94	2360.59
S-6	128.98	1525.96	S-6	131.43	1429.98
A-2	219.83	2055.78	A-2	241.62	2049.77
B-2	248.96	2655.29	B-2	244.69	2584.93
C-1	305.21	2257.82	C-1	403.62	2168.66

ANALYSIS

SUBJ	E CELL VALUE	G CELL VALUE	DIFFERENCE (E - G)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
H-6	2030.76	1951.51	79.25	4.00	0.00	4.00
B-1	1890.23	1785.80	104.43	6.00	0.00	6.00
P-3	2338.95	2155.72	183.23	8.00	0.00	8.00
W-4	2166.94	1901.66	265.28	12.00	0.00	12.00
C-2	2077.70	1926.27	151.43	7.00	0.00	7.00
B-3	2081.82	1784.45	297.37	13.00	0.00	13.00
M13	2117.59	1898.07	219.52	11.00	0.00	11.00
J-4	2263.37	1904.29	359.08	14.00	0.00	14.00
W-3	1975.08	1915.46	59.62	2.00	0.00	2.00
K-1	2198.46	2013.65	184.81	9.00	0.00	9.00
S-6	1396.98	1298.55	98.43	5.00	0.00	5.00
A-2	1835.95	1808.15	27.80	1.00	0.00	1.00
B-2	2406.33	2340.24	66.09	3.00	0.00	3.00
C-1	1952.61	1765.04	187.57	10.00	0.00	10.00

MEAN E: 2052.34 STD DEV E: 249.80 SUM OF NEG RANKS: 0.00  
 MEAN G: 1889.20 STD DEV G: 230.20 SUM OF POS RANKS: 105.00

THERE IS A 8% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON F-H

## ANALYSIS OF CARRIAGE Z ACCELERATION (G)

(IMPACT MAXIMUM)

SUBJ	F CELL VALUE	H CELL VALUE	DIFFERENCE (F - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
S-6	10.12	10.04	0.08	9.50	0.00	9.50
C-1	9.94	10.00	-0.06	6.50	6.50	0.00
M-4	9.90	10.03	-0.13	13.00	13.00	0.00
K-1	9.88	9.94	-0.06	5.00	5.00	0.00
J-4	9.91	9.93	-0.02	1.00	1.00	0.00
A-3	9.94	10.00	-0.06	6.50	6.50	0.00
B-2	9.94	9.99	-0.05	3.50	3.50	0.00
B-3	9.94	10.04	-0.10	12.00	12.00	0.00
A-2	9.95	10.02	-0.07	8.00	8.00	0.00
H-6	9.89	10.03	-0.14	14.00	14.00	0.00
M-3	9.93	9.96	-0.03	2.00	2.00	0.00
M13	9.88	10.04	-0.16	15.00	15.00	0.00
B-1	9.95	10.03	-0.08	9.50	9.50	0.00
C-2	9.92	10.01	-0.09	11.00	11.00	0.00
E-2	10.09	10.04	0.05	3.50	0.00	3.50
P-3	9.88	9.88	0.00	0.00	0.00	0.00

MEAN F: 9.94 STD DEV F: 0.07 SUM OF NEG RANKS: 107.00  
 MEAN H: 10.00 STD DEV H: 0.05 SUM OF POS RANKS: 13.00

THERE IS A 1% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON F-H

## ANALYSIS OF CARRIAGE VELOCITY (FT/SEC)

(IMPACT MINIMUM)

SUBJ	F CELL VALUE	H CELL VALUE	DIFFERENCE (F - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
S-6	-26.27	-26.22	-0.05	2.50	2.50	0.00
C-1	-26.25	-26.25	0.00	0.00	0.00	0.00
M-4	-26.34	-25.49	-0.85	15.00	15.00	0.00
K-1	-26.23	-26.36	0.13	7.00	0.00	7.00
J-4	-26.26	-26.36	0.10	4.00	0.00	4.00
A-3	-26.32	-26.18	-0.14	8.00	8.00	0.00
B-2	-26.22	-26.27	0.05	2.50	0.00	2.50
B-3	-26.28	-25.64	-0.64	14.00	14.00	0.00
A-2	-26.76	-26.25	-0.51	13.00	13.00	0.00
H-6	-26.37	-26.26	-0.11	5.50	5.50	0.00
M-3	-26.36	-26.25	-0.11	5.50	5.50	0.00
M13	-26.48	-26.02	-0.46	12.00	12.00	0.00
B-1	-26.42	-26.20	-0.22	11.00	11.00	0.00
C-2	-26.39	-26.19	-0.20	10.00	10.00	0.00
E-2	-26.25	-26.20	-0.05	1.00	1.00	0.00
P-3	-26.25	-26.42	0.17	9.00	0.00	9.00

MEAN F: -26.34 STD DEV F: 0.13 SUM OF NEG RANKS: 97.50  
 MEAN H: -26.16 STD DEV H: 0.25 SUM OF POS RANKS: 22.50

THERE IS A 0.4% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.05$ ).

# WILCOXON COMPARISON F-H

## ANALYSIS OF CHEST Z ACCELERATION (G)

(IMPACT MAXIMUM)

SUBJ	F CELL VALUE	H CELL VALUE	DIFFERENCE (F - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
S-6	18.12	13.73	4.39	10.00	0.00	10.00
C-1	16.97	14.69	2.28	4.00	0.00	4.00
W-4	21.81	16.07	5.74	14.00	0.00	14.00
K-1	21.00	15.49	5.51	13.00	0.00	13.00
J-4	22.77	15.96	6.81	16.00	0.00	16.00
A-3	20.36	17.48	2.88	5.00	0.00	5.00
B-2	19.70	16.51	3.19	6.00	0.00	6.00
B-3	17.04	13.24	3.80	8.00	0.00	8.00
A-2	18.05	13.72	4.33	9.00	0.00	9.00
H-6	20.67	14.01	6.66	15.00	0.00	15.00
W-3	15.56	14.59	0.97	3.00	0.00	3.00
M13	19.62	15.98	3.64	7.00	0.00	7.00
B-1	20.91	16.21	4.70	11.00	0.00	11.00
C-2	19.66	14.22	5.44	12.00	0.00	12.00
E-2	13.91	14.61	-0.70	2.00	2.00	0.00
P-3	15.18	15.08	0.10	1.00	0.00	1.00

MEAN F: 18.83 STD DEV F: 2.55 SUM OF NEG RANKS: 2.00  
 MEAN H: 15.10 STD DEV H: 1.19 SUM OF POS RANKS: 134.00

THERE IS A 25% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON F-H

## ANALYSIS OF CHEST RESULTANT ACCELERATION

(IMPACT MAXIMUM)

SUBJ	F CELL VALUE	H CELL VALUE	DIFFERENCE (F - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
S-6	18.15	13.76	4.39	9.00	0.00	9.00
C-1	17.06	15.04	2.02	4.00	0.00	4.00
W-4	21.88	16.49	5.39	12.00	0.00	12.00
K-1	21.37	15.93	5.44	13.00	0.00	13.00
J-4	22.89	16.16	6.73	16.00	0.00	16.00
A-3	20.67	17.77	2.90	5.00	0.00	5.00
B-2	19.83	16.58	3.25	6.00	0.00	6.00
B-3	17.20	13.81	3.39	7.00	0.00	7.00
A-2	18.20	13.79	4.41	10.00	0.00	10.00
H-6	20.85	14.33	6.52	15.00	0.00	15.00
W-3	15.61	14.59	1.02	3.00	0.00	3.00
M13	19.69	16.13	3.56	8.00	0.00	8.00
B-1	21.37	16.31	5.06	11.00	0.00	11.00
C-2	20.12	14.54	5.58	14.00	0.00	14.00
E-2	14.10	14.65	-0.55	1.00	1.00	0.00
P-3	16.31	15.66	0.65	2.00	0.00	2.00

MEAN F: 19.08 STD DEV F: 2.51 SUM OF NEG RANKS: 1.00  
 MEAN H: 15.35 STD DEV H: 1.20 SUM OF POS RANKS: 135.00

THERE IS A 25% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON F-H

## ANALYSIS OF CHEST SEVERITY INDEX

(IMPACT MAXIMUM)

SUBJ	F CELL VALUE	H CELL VALUE	DIFFERENCE (F - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
S-6	33.10	24.16	8.94	10.00	0.00	10.00
C-1	32.65	27.89	4.76	4.00	0.00	4.00
W-4	39.36	29.25	10.11	12.00	0.00	12.00
K-1	41.66	30.01	11.65	14.00	0.00	14.00
J-4	44.98	30.15	14.83	15.00	0.00	15.00
A-3	36.39	27.58	8.81	9.00	0.00	9.00
B-2	34.70	27.70	7.00	6.00	0.00	6.00
B-3	31.94	24.60	7.34	7.00	0.00	7.00
A-2	31.83	26.94	4.89	5.00	0.00	5.00
H-6	41.70	26.76	14.94	16.00	0.00	16.00
W-3	30.88	28.73	2.15	1.00	0.00	1.00
M13	35.43	25.67	9.76	11.00	0.00	11.00
B-1	38.81	27.87	10.94	13.00	0.00	13.00
C-2	36.65	28.24	8.41	8.00	0.00	8.00
E-2	26.29	23.21	3.08	2.00	0.00	2.00
P-3	32.31	28.01	4.30	3.00	0.00	3.00

MEAN F: 35.54 STD DEV F: 4.84 SUM OF NEG RANKS: 0.00  
 MEAN H: 27.30 STD DEV H: 2.01 SUM OF POS RANKS: 136.00

THERE IS A 30% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON F-H

## ANALYSIS OF HEAD Z ACCELERATION (G)

(IMPACT MAXIMUM)

SUBJ	F CELL VALUE	H CELL VALUE	DIFFERENCE (F - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
S-6	11.22	10.81	0.41	5.00	0.00	5.00
C-1	11.16	11.49	-0.33	3.00	3.00	0.00
W-4	12.71	10.70	2.01	16.00	0.00	16.00
K-1	12.93	12.49	0.44	6.00	0.00	6.00
J-4	12.43	12.45	-0.02	1.00	1.00	0.00
A-3	13.86	12.93	0.93	10.00	0.00	10.00
B-2	11.88	11.35	0.53	8.00	0.00	8.00
B-3	13.06	11.78	1.28	13.00	0.00	13.00
A-2	13.23	12.29	0.94	11.00	0.00	11.00
H-6	12.07	10.09	1.98	15.00	0.00	15.00
W-3	12.65	11.22	1.43	14.00	0.00	14.00
M13	12.29	12.07	0.22	2.00	0.00	2.00
B-1	14.56	14.21	0.35	4.00	0.00	4.00
C-2	11.92	10.69	1.23	12.00	0.00	12.00
E-2	11.14	10.68	0.46	7.00	0.00	7.00
P-3	12.96	12.10	0.86	9.00	0.00	9.00

MEAN F: 12.50 STD DEV F: 0.95 SUM OF NEG RANKS: 4.00  
 MEAN H: 11.71 STD DEV H: 1.05 SUM OF POS RANKS: 132.00

THERE IS A 7% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON F-H

## ANALYSIS OF HEAD RESULTANT ACCELERATION

(IMPACT MAXIMUM)

SUBJ	F CELL VALUE	H CELL VALUE	DIFFERENCE (F - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
S-6	11.22	10.95	0.27	4.00	0.00	4.00
C-1	12.36	11.99	0.37	6.50	0.00	6.50
M-4	13.17	11.51	1.66	15.00	0.00	15.00
K-1	13.00	12.63	0.37	6.50	0.00	6.50
J-4	12.94	13.05	-0.11	2.00	2.00	0.00
A-3	13.92	12.95	0.97	9.50	0.00	9.50
B-2	12.52	11.97	0.55	8.00	0.00	8.00
B-3	13.49	12.05	1.44	13.00	0.00	13.00
A-2	13.29	12.32	0.97	9.50	0.00	9.50
H-6	13.64	11.04	2.60	16.00	0.00	16.00
M-3	12.81	11.24	1.57	14.00	0.00	14.00
M13	12.48	12.50	-0.02	1.00	1.00	0.00
B-1	14.58	14.27	0.31	5.00	0.00	5.00
C-2	12.12	11.02	1.10	12.00	0.00	12.00
E-2	11.41	11.27	0.14	3.00	0.00	3.00
P-3	13.21	12.22	0.99	11.00	0.00	11.00

MEAN F: 12.89 STD DEV F: 0.87 SUM OF NEG RANKS: 3.00  
 MEAN H: 12.06 STD DEV H: 0.90 SUM OF POS RANKS: 133.00

THERE IS A 7% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON F-H

## ANALYSIS OF HEAD SEVERITY INDEX

(IMPACT MAXIMUM)

SUBJ	F CELL VALUE	H CELL VALUE	DIFFERENCE (F - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
S-6	18.06	17.17	0.89	3.00	0.00	3.00
C-1	23.05	20.22	2.83	13.00	0.00	13.00
M-4	19.97	18.18	1.79	11.00	0.00	11.00
K-1	21.39	19.92	1.47	8.00	0.00	8.00
J-4	23.98	24.10	-0.12	1.00	1.00	0.00
A-3	22.69	19.91	2.78	12.00	0.00	12.00
B-2	19.12	19.72	-0.60	2.00	2.00	0.00
B-3	21.68	19.92	1.76	10.00	0.00	10.00
A-2	22.83	21.13	1.70	9.00	0.00	9.00
H-6	24.02	19.32	4.70	16.00	0.00	16.00
M-3	24.49	21.65	2.84	14.00	0.00	14.00
M13	20.83	19.52	1.31	6.00	0.00	6.00
B-1	23.44	22.02	1.42	7.00	0.00	7.00
C-2	22.70	19.79	2.91	15.00	0.00	15.00
E-2	19.39	18.39	1.00	4.00	0.00	4.00
P-3	23.19	22.01	1.18	5.00	0.00	5.00

MEAN F: 21.93 STD DEV F: 1.95 SUM OF NEG RANKS: 3.00  
 MEAN H: 20.19 STD DEV H: 1.70 SUM OF POS RANKS: 133.00

THERE IS A 8% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).



# WILCOXON COMPARISON F-H

## ANALYSIS OF TOTAL SHOULDER STRAP LOAD (LB)

(FREEFALL MAXIMUM)

SUBJ	F CELL VALUE	H CELL VALUE	DIFFERENCE (F - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
S-6	55.21	74.08	-18.87	1.00	1.00	0.00
C-1	113.33	203.67	-90.34	13.00	13.00	0.00
W-4	52.78	97.84	-45.06	8.00	8.00	0.00
K-1	51.62	150.62	-99.00	15.00	15.00	0.00
J-4	93.88	136.44	-42.56	7.00	7.00	0.00
A-3	53.58	80.63	-27.05	3.00	3.00	0.00
B-2	108.42	134.56	-26.14	2.00	2.00	0.00
B-3	70.22	137.21	-66.99	12.00	12.00	0.00
A-2	41.98	76.40	-34.42	5.00	5.00	0.00
H-6	77.12	171.78	-94.66	14.00	14.00	0.00
W-3	101.35	162.45	-61.10	11.00	11.00	0.00
M13	63.70	116.51	-52.81	10.00	10.00	0.00
B-1	52.47	89.95	-37.48	6.00	6.00	0.00
C-2	45.98	75.92	-29.94	4.00	4.00	0.00
E-2	154.87	203.78	-48.91	9.00	9.00	0.00
P-3	78.58	182.10	-103.52	16.00	16.00	0.00

MEAN F: 75.94 STD DEV F: 31.09 SUM OF NEG RANKS: 136.00 -----  
 MEAN H: 130.87 STD DEV H: 45.53 SUM OF POS RANKS: ----- 0.00

THERE IS A 72% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON F-H

## ANALYSIS OF TOTAL LAP BELT LOAD (LB)

(FREEFALL MAXIMUM)

SUBJ	F CELL VALUE	H CELL VALUE	DIFFERENCE (F - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
S-6	177.43	203.77	-26.34	6.00	6.00	0.00
C-1	317.98	376.61	-58.63	10.00	10.00	0.00
W-4	236.93	225.99	10.94	3.00	0.00	3.00
K-1	237.82	255.00	-17.18	5.00	5.00	0.00
J-4	266.87	250.03	16.84	4.00	0.00	4.00
A-3	241.52	386.70	-145.18	16.00	16.00	0.00
B-2	212.94	221.20	-8.26	1.00	1.00	0.00
B-3	308.79	352.50	-43.71	7.00	7.00	0.00
A-2	224.42	284.05	-59.63	11.00	11.00	0.00
H-6	225.03	292.18	-67.15	13.00	13.00	0.00
W-3	186.67	176.75	9.92	2.00	0.00	2.00
M13	272.18	363.16	-90.98	14.00	14.00	0.00
B-1	137.48	249.88	-112.40	15.00	15.00	0.00
C-2	146.02	196.87	-50.85	9.00	9.00	0.00
E-2	361.46	296.71	64.75	12.00	0.00	12.00
P-3	356.47	307.22	49.25	8.00	0.00	8.00

MEAN F: 244.38 STD DEV F: 67.28 SUM OF NEG RANKS: 107.00 -----  
 MEAN H: 277.41 STD DEV H: 66.41 SUM OF POS RANKS: ----- 29.00

THERE IS A 14% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.05$ ).

# WILCOXON COMPARISON F-H

## ANALYSIS OF NEGATIVE G STRAP LOAD (LB)

(FREEFALL MAXIMUM)

SUBJ	F CELL VALUE	H CELL VALUE	DIFFERENCE (F - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
S-6	39.26	128.08	-88.82	2.00	2.00	0.00
C-1	100.59	316.33	-215.74	15.00	15.00	0.00
M-4	111.64	245.32	-133.68	7.00	7.00	0.00
K-1	84.36	220.80	-136.44	9.00	9.00	0.00
J-4	102.98	210.25	-107.27	4.00	4.00	0.00
A-3	66.88	217.48	-150.60	11.00	11.00	0.00
B-2	112.37	232.62	-120.25	6.00	6.00	0.00
B-3	104.04	270.00	-165.96	13.00	13.00	0.00
A-2	41.70	127.37	-85.67	1.00	1.00	0.00
H-6	98.11	326.48	-228.37	16.00	16.00	0.00
M-3	56.92	194.13	-137.21	10.00	10.00	0.00
M13	35.27	170.01	-134.74	8.00	8.00	0.00
B-1	31.48	137.34	-105.86	3.00	3.00	0.00
C-2	50.61	170.67	-120.06	5.00	5.00	0.00
E-2	120.41	319.71	-199.30	14.00	14.00	0.00
P-3	121.55	284.54	-162.99	12.00	12.00	0.00

MEAN F: 79.89 STD DEV F: 33.00 SUM OF NEG RANKS: 136.00  
 MEAN H: 223.20 STD DEV H: 67.05 SUM OF POS RANKS: 0.00

THERE IS A 179% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON F-H

## ANALYSIS OF TOTAL SHOULDER STRAP LOAD (LB)

(IMPACT MAXIMUM MINUS FREEFALL MAXIMUM)

### DATA

CONDITION F			CONDITION H		
SUBJ	FREEFALL MAXIMUM	IMPACT MAXIMUM	SUBJ	FREEFALL MAXIMUM	IMPACT MAXIMUM
S-6	55.21	152.17	S-6	74.08	153.31
C-1	113.33	225.53	C-1	203.67	187.10
M-4	52.78	173.52	M-4	97.84	169.85
K-1	51.62	172.03	K-1	150.62	138.51
J-4	93.88	192.39	J-4	136.44	149.39
A-3	53.58	182.60	A-3	80.63	158.92
B-2	108.42	193.84	B-2	134.56	136.93
B-3	70.22	141.47	B-3	137.21	112.07
A-2	41.98	113.73	A-2	76.40	118.14
H-6	77.12	243.28	H-6	171.78	240.12
M-3	101.35	182.40	M-3	162.45	219.15
M13	63.70	150.18	M13	116.51	143.88
B-1	52.47	103.37	B-1	89.95	94.78
C-2	45.98	176.73	C-2	75.92	193.41
E-2	154.87	316.09	E-2	203.78	319.34
P-3	78.58	198.16	P-3	182.10	204.56

### ANALYSIS

SUBJ	F CELL VALUE	H CELL VALUE	DIFFERENCE (F - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
S-6	96.96	79.23	17.73	2.00	0.00	2.00
C-1	112.20	-16.57	128.77	15.00	0.00	15.00
M-4	120.74	72.01	48.73	7.00	0.00	7.00
K-1	120.41	-12.11	132.52	16.00	0.00	16.00
J-4	98.51	12.95	85.56	11.00	0.00	11.00
A-3	129.02	78.29	50.73	8.00	0.00	8.00
B-2	85.42	2.37	83.05	10.00	0.00	10.00
B-3	71.25	-25.14	96.39	12.00	0.00	12.00
A-2	71.75	41.74	30.01	4.00	0.00	4.00
H-6	166.16	68.34	97.82	14.00	0.00	14.00
M-3	81.05	56.70	24.35	3.00	0.00	3.00
M13	86.48	27.37	59.11	9.00	0.00	9.00
B-1	50.90	4.83	46.07	6.00	0.00	6.00
C-2	130.75	117.49	13.26	1.00	0.00	1.00
E-2	161.22	115.56	45.66	5.00	0.00	5.00
P-3	119.58	22.46	97.12	13.00	0.00	13.00

MEAN F: 106.40 STD DEV F: 32.08 SUM OF NEG RANKS: 0.00  
 MEAN H: 40.35 STD DEV H: 45.34 SUM OF POS RANKS: 136.00

THERE IS A 165% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON F-H

ANALYSIS OF NEGATIVE G STRAP LOAD (LB)

(IMPACT MAXIMUM MINUS IMPACT MINIMUM)

DATA

CONDITION F			CONDITION H		
SUBJ	IMPACT MINIMUM	IMPACT MAXIMUM	SUBJ	IMPACT MINIMUM	IMPACT MAXIMUM
S-6	-7.81	21.06	S-6	32.06	114.27
C-1	-4.84	46.62	C-1	84.74	223.44
W-4	16.24	59.55	W-4	92.81	207.03
K-1	-3.50	20.97	K-1	18.09	93.40
J-4	-2.46	54.65	J-4	42.05	154.39
A-3	-6.55	19.81	A-3	36.73	116.43
B-2	-6.25	34.87	B-2	33.66	120.27
B-3	-3.90	37.72	B-3	48.45	105.56
A-2	-7.88	8.44	A-2	18.16	91.59
H-6	-5.45	41.62	H-6	109.96	234.22
W-3	-8.35	29.94	W-3	25.31	168.40
M13	-8.66	15.82	M13	28.17	110.38
B-1	-9.94	14.54	B-1	17.47	122.91
C-2	2.91	41.82	C-2	80.30	194.52
E-2	-1.97	71.46	E-2	151.52	244.40
P-3	16.12	90.80	P-3	91.87	221.15

ANALYSIS

SUBJ	F CELL VALUE	H CELL VALUE	DIFFERENCE (F - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
S-6	28.87	82.21	-53.34	5.00	5.00	0.00
C-1	51.46	138.70	-87.24	15.00	15.00	0.00
W-4	43.31	114.22	-70.91	11.00	11.00	0.00
K-1	24.47	75.31	-50.84	4.00	4.00	0.00
J-4	57.11	112.34	-55.23	8.00	8.00	0.00
A-3	26.36	79.70	-53.34	6.00	6.00	0.00
B-2	41.12	86.61	-45.49	3.00	3.00	0.00
B-3	41.62	57.11	-15.49	1.00	1.00	0.00
A-2	16.32	73.43	-57.11	9.00	9.00	0.00
H-6	47.07	124.26	-77.19	13.00	13.00	0.00
W-3	38.29	143.09	-104.80	16.00	16.00	0.00
M13	24.48	82.21	-57.73	10.00	10.00	0.00
B-1	24.48	105.44	-80.96	14.00	14.00	0.00
C-2	38.91	114.22	-75.31	12.00	12.00	0.00
E-2	73.43	92.88	-19.45	2.00	2.00	0.00
P-3	74.68	129.28	-54.60	7.00	7.00	0.00

MEAN F: 40.75 STD DEV F: 17.12 SUM OF NEG RANKS: 136.00  
 MEAN H: 100.69 STD DEV H: 25.57 SUM OF POS RANKS: 0.00

THERE IS A 146% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON F-H

## ANALYSIS OF VERTICAL SEAT LOAD (LB)

(FREEFALL MAXIMUM)

SUBJ	F CELL VALUE	H CELL VALUE	DIFFERENCE (F - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
S-6	141.81	212.31	-70.50	3.00	3.00	0.00
C-1	321.68	597.40	-275.72	16.00	16.00	0.00
M-4	309.63	408.54	-98.91	6.00	6.00	0.00
K-1	291.38	431.52	-140.14	11.00	11.00	0.00
J-4	393.14	418.47	-25.33	1.00	1.00	0.00
A-3	239.41	455.21	-215.80	14.00	14.00	0.00
B-2	267.18	388.58	-121.40	9.00	9.00	0.00
B-3	342.07	518.15	-176.08	13.00	13.00	0.00
A-2	249.51	310.47	-60.96	2.00	2.00	0.00
H-6	263.73	504.73	-241.00	15.00	15.00	0.00
M-3	233.65	321.83	-88.18	5.00	5.00	0.00
M13	261.27	404.38	-143.11	12.00	12.00	0.00
B-1	188.80	292.72	-103.92	7.00	7.00	0.00
C-2	208.35	286.10	-77.75	4.00	4.00	0.00
E-2	348.98	484.18	-135.20	10.00	10.00	0.00
P-3	405.88	525.11	-119.23	8.00	8.00	0.00

MEAN F: 279.15 STD DEV F: 72.13 SUM OF NEG RANKS: 136.00  
 MEAN H: 409.98 STD DEV H: 104.40 SUM OF POS RANKS: 0.00

THERE IS A 47% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON F-H

## ANALYSIS OF RESULTANT SEAT LOAD (LB)

(FREEFALL MAXIMUM)

SUBJ	F CELL VALUE	H CELL VALUE	DIFFERENCE (F - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
S-6	141.84	213.95	-72.11	3.00	3.00	0.00
C-1	322.19	599.87	-277.68	16.00	16.00	0.00
M-4	310.01	409.12	-99.11	7.00	7.00	0.00
K-1	291.46	432.61	-141.15	12.00	12.00	0.00
J-4	394.01	418.61	-24.60	1.00	1.00	0.00
A-3	239.42	457.88	-218.46	14.00	14.00	0.00
B-2	269.05	388.74	-119.69	9.00	9.00	0.00
B-3	345.42	518.37	-172.95	13.00	13.00	0.00
A-2	251.09	311.01	-59.92	2.00	2.00	0.00
H-6	263.96	505.73	-241.77	15.00	15.00	0.00
M-3	237.02	324.34	-87.32	5.00	5.00	0.00
M13	277.93	409.24	-131.31	10.00	10.00	0.00
B-1	205.21	293.52	-88.31	6.00	6.00	0.00
C-2	208.65	287.17	-78.52	4.00	4.00	0.00
E-2	350.31	486.30	-135.99	11.00	11.00	0.00
P-3	406.14	525.63	-119.49	8.00	8.00	0.00

MEAN F: 282.11 STD DEV F: 70.88 SUM OF NEG RANKS: 136.00  
 MEAN H: 411.38 STD DEV H: 104.46 SUM OF POS RANKS: 0.00

THERE IS A 46% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON F-H

## ANALYSIS OF HORIZONTAL SEAT LOAD (LB)

(IMPACT MINIMUM MINUS FREEFALL MAXIMUM)

### DATA

CONDITION F			CONDITION H		
SUBJ	FREEFALL MAXIMUM	IMPACT MINIMUM	SUBJ	FREEFALL MAXIMUM	IMPACT MINIMUM
S-6	53.60	-26.56	S-6	23.53	-21.53
C-1	14.03	-50.56	C-1	71.15	-0.35
M-4	4.11	-77.54	M-4	-2.81	-53.01
K-1	3.99	-73.75	K-1	40.26	-31.14
J-4	19.42	-34.79	J-4	0.32	-31.84
A-3	3.50	-41.59	A-3	30.64	-18.88
B-2	63.30	-39.67	B-2	39.73	-44.54
B-3	63.93	1.18	B-3	1.10	-23.52
A-2	30.47	8.05	A-2	-0.82	-14.39
H-6	5.62	-67.97	H-6	35.89	-31.74
M-3	46.19	-31.48	M-3	6.21	-59.79
M13	92.32	-9.05	M13	80.37	9.20
B-1	43.98	-67.04	B-1	0.16	-61.33
C-2	2.34	-84.90	C-2	-1.49	-69.56
E-2	2.13	-71.11	E-2	-4.94	-89.56
P-3	3.40	-86.31	P-3	-6.91	-61.84

### ANALYSIS

SUBJ	F CELL VALUE	H CELL VALUE	DIFFERENCE (F - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
S-6	-80.16	-45.06	-35.10	14.00	14.00	0.00
C-1	-64.59	-71.50	6.91	4.00	0.00	4.00
M-4	-81.65	-50.20	-31.45	12.00	12.00	0.00
K-1	-77.74	-71.40	-6.34	3.00	3.00	0.00
J-4	-54.21	-32.16	-22.05	10.00	10.00	0.00
A-3	-45.09	-49.52	4.43	1.00	0.00	1.00
B-2	-102.97	-84.27	-18.70	8.00	8.00	0.00
B-3	-62.75	-24.62	-38.13	15.00	15.00	0.00
A-2	-22.42	-13.57	-8.85	5.00	5.00	0.00
H-6	-73.59	-67.63	-5.96	2.00	2.00	0.00
M-3	-77.67	-66.00	-11.67	7.00	7.00	0.00
M13	-101.37	-71.17	-30.20	11.00	11.00	0.00
B-1	-111.02	-61.49	-49.53	16.00	16.00	0.00
C-2	-87.24	-68.07	-19.17	9.00	9.00	0.00
E-2	-73.24	-84.62	11.38	6.00	0.00	6.00
P-3	-89.71	-54.93	-34.78	13.00	13.00	0.00

MEAN F: -75.34 STD DEV F: 22.48 SUM OF NEG RANKS: 125.00  
 MEAN H: -57.26 STD DEV H: 20.43 SUM OF POS RANKS: 11.00

THERE IS A 32% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON F-H

ANALYSIS OF RESULTANT SEAT LOAD (LB)

(IMPACT MAXIMUM MINUS FREEFALL MAXIMUM)

## DATA

CONDITION F			CONDITION H		
SUBJ	FREEFALL MAXIMUM	IMPACT MAXIMUM	SUBJ	FREEFALL MAXIMUM	IMPACT MAXIMUM
S-6	141.84	1531.86	S-6	213.95	1477.82
C-1	322.19	2152.82	C-1	599.87	2269.66
W-4	310.01	2368.94	W-4	409.12	2245.18
K-1	291.46	2373.88	K-1	432.61	2320.32
J-4	394.01	2514.05	J-4	418.61	2558.23
A-3	239.42	2063.67	A-3	457.88	2042.58
B-2	269.05	2801.73	B-2	388.74	2456.90
B-3	345.42	2343.73	B-3	518.37	2330.56
A-2	251.09	2024.54	A-2	311.01	1958.04
H-6	263.96	2362.23	H-6	505.73	2259.65
W-3	237.02	2199.40	W-3	324.34	2060.55
M13	277.93	2333.01	M13	409.24	2115.78
B-1	205.21	2026.29	B-1	293.52	1925.48
C-2	208.65	2182.25	C-2	287.17	2149.74
E-2	350.31	1951.75	E-2	486.30	1968.16
P-3	406.14	2677.35	P-3	525.63	2673.33

## ANALYSIS

SUBJ	F CELL VALUE	H CELL VALUE	DIFFERENCE (F - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
S-6	1390.02	1263.87	126.15	5.00	0.00	5.00
C-1	1830.63	1669.79	160.84	7.00	0.00	7.00
W-4	2058.93	1836.06	222.87	11.00	0.00	11.00
K-1	2082.42	1887.71	194.71	10.00	0.00	10.00
J-4	2120.04	2139.62	-19.58	1.00	1.00	0.00
A-3	1824.25	1584.70	239.55	13.00	0.00	13.00
B-2	2532.68	2068.16	464.52	16.00	0.00	16.00
B-3	1998.31	1812.19	186.12	8.00	0.00	8.00
A-2	1773.45	1647.03	126.42	6.00	0.00	6.00
H-6	2098.27	1753.92	344.35	14.00	0.00	14.00
W-3	1962.38	1736.21	226.17	12.00	0.00	12.00
M13	2055.08	1706.54	348.54	15.00	0.00	15.00
B-1	1821.08	1631.96	189.12	9.00	0.00	9.00
C-2	1973.60	1862.57	111.03	2.00	0.00	2.00
E-2	1601.44	1481.86	119.58	3.00	0.00	3.00
P-3	2271.21	2147.70	123.51	4.00	0.00	4.00

MEAN F: 1962.11    STD DEV F: 264.28    SUM OF NEG RANKS: 1.00  
 MEAN H: 1764.37    STD DEV H: 233.72    SUM OF POS RANKS: 135.00

THERE IS A 11% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON F-H

## ANALYSIS OF VERTICAL SEAT LOAD (LB)

(IMPACT MAXIMUM MINUS FREEFALL MAXIMUM)

### DATA

CONDITION F			CONDITION H		
SUBJ	FREEFALL MAXIMUM	IMPACT MAXIMUM	SUBJ	FREEFALL MAXIMUM	IMPACT MAXIMUM
S-6	141.81	1531.51	S-6	212.31	1477.75
C-1	321.68	2151.59	C-1	597.40	2269.51
W-4	309.63	2367.31	W-4	408.54	2244.50
K-1	291.38	2372.74	K-1	431.52	2319.19
J-4	393.14	2512.18	J-4	418.47	2557.92
A-3	239.41	2063.21	A-3	455.21	2039.54
B-2	267.18	2798.15	B-2	388.58	2456.90
B-3	342.07	2341.32	B-3	518.15	2330.34
A-2	249.51	2023.19	A-2	310.47	1957.14
H-6	263.73	2361.13	H-6	504.73	2259.57
W-3	233.65	2194.75	W-3	321.83	2059.74
M13	261.27	2332.14	M13	404.38	2113.67
B-1	188.80	2025.22	B-1	292.72	1924.38
C-2	208.35	2180.78	C-2	286.10	2148.73
E-2	348.98	1950.09	E-2	484.18	1966.45
P-3	405.88	2676.05	P-3	525.11	2672.47

### ANALYSIS

SUBJ	F CELL VALUE	H CELL VALUE	DIFFERENCE (F - H)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
S-6	1389.70	1265.44	124.26	5.00	0.00	5.00
C-1	1829.91	1672.11	157.80	7.00	0.00	7.00
W-4	2057.68	1835.96	221.72	11.00	0.00	11.00
K-1	2081.36	1887.67	193.69	9.00	0.00	9.00
J-4	2119.04	2139.45	-20.41	1.00	1.00	0.00
A-3	1823.80	1584.33	239.47	13.00	0.00	13.00
B-2	2530.97	2068.32	462.65	16.00	0.00	16.00
B-3	1999.25	1812.19	187.06	8.00	0.00	8.00
A-2	1773.68	1646.67	127.01	6.00	0.00	6.00
H-6	2097.40	1754.84	342.56	14.00	0.00	14.00
W-3	1961.10	1737.91	223.19	12.00	0.00	12.00
M13	2070.87	1709.29	361.58	15.00	0.00	15.00
B-1	1836.42	1631.66	204.76	10.00	0.00	10.00
C-2	1972.43	1862.63	109.80	2.00	0.00	2.00
E-2	1601.11	1482.27	118.84	3.00	0.00	3.00
P-3	2270.17	2147.36	122.81	4.00	0.00	4.00

MEAN F: 1963.43    STD DEV F: 263.81    SUM OF NEG RANKS: 1.00  
 MEAN H: 1764.88    STD DEV H: 233.34    SUM OF POS RANKS: 135.00

THERE IS A 11% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).



## APPENDIX E

### PHOTOMETRIC DATA

Subject head and knee displacements resulting from fore-aft impacts were determined by analyzing high-speed films of the experiments. Available displacement data for forward facing tests are summarized in Table E-1. Component displacements were defined as maximum minus minimum coordinate values of photometric targets displaced during the impact. Resultant displacements were computed vectorially as the maximum displacement from the target's initial vector position. Data from some experiments were not available due to problems acquiring or processing the films (e.g., camera malfunction during impact). Further details concerning photometric data acquisition are contained in Appendix B.

Locations of subject-mounted photometric targets or fiducials were generally in accordance with the guidelines provided in "Film Analysis Guide for Dynamic Studies of Test Subjects, Recommended Practice" (SAE J138, March 1980). Figures E-1 and E-2 document the fiducial locations used for each phase of this study. Figure E-3 shows the origin and orientation of the left-handed photometric coordinate system.

These data were analyzed by means of the Wilcoxon paired-replicate rank test. The analyses were two-tailed tests with the 90% confidence level chosen as the level of statistical significance. The Wilcoxon comparisons of parameters for which there were statistically significant differences are also presented in this appendix. These statistically significant trends are summarized in the body of the report in Tables 4 and 6.

Digitized film frame data, acquired as described in Appendix B, were processed on a Control Data Corporation Cyber 74 computer system. Generally, the analysis required that a photometric target be viewed by two cameras, the locations and orientations of which were precisely known. The position data, digitized with respect to the individual film frames, were then combined to fix the three-dimensional target position with respect to the real-space seat coordinate system (Figure B-7). Details of the pertinent software routines used in this process are described elsewhere (Graf *et al.*, 1978; Brinkley *et al.*, 1981).

Modifications were made to the existing software in order to calculate the vector displacement of a target from its initial position. An algorithm, which subtracted the initial or pre-impact fiducial position vector from each subsequent position vector throughout the impact, was implemented. The magnitudes of these resultant displacement vectors were calculated and, for each target, the maximum resultant displacement was determined. Analysis outputs included position-time and displacement-time histories for the head and knee fiducials. The time increment between data points was 1 millisecond.

The accuracy of the photometric data reduction system in tracking static fiducials was assessed. Five fiducials were placed on the horizontal test fixture at various locations. These stationary photometric targets were filmed and the target positions were digitized in the usual fashion. The computed coordinate positions of these fixed targets were then compared to the coordinate values obtained by direct measurement with a yardstick. In this way, the differences between computed and measured positions were obtained. This technique revealed that the photometric data reduction system was accurate to within 0.07 inches  $\pm$  0.04 inches at the 95% confidence level. The resolution and ultimate accuracy of the manual measurements was also in the 0.05 to 0.10 inch range.

TABLE E-1  
MAXIMUM HEAD AND KNEE DISPLACEMENTS (INCHES)  
FROM HORIZONTAL TEST PHASE

CELL OF MATRIX		A		B	
SUBJ	DISPLACEMENT	HEAD	KNEE	HEAD	KNEE
B-1	HORIZONTAL	8.3	4.6	8.4	4.2
	VERTICAL	7.5	8.2	6.7	7.8
	RESULTANT	10.6	7.7	10.2	7.5
B-2	HORIZONTAL			8.5	7.1
	VERTICAL			6.9	11.6
	RESULTANT			10.6	11.0
B-3	HORIZONTAL	7.1	5.2	7.2	6.2
	VERTICAL	5.0	8.2	5.6	9.8
	RESULTANT	8.4	8.3	8.8	10.3
B-4	HORIZONTAL				
	VERTICAL				
	RESULTANT				
C-1	HORIZONTAL	10.3	4.9	9.2	3.4
	VERTICAL	8.9	10.3	7.0	7.6
	RESULTANT	12.9	10.1	11.0	7.5
C-2	HORIZONTAL	9.1	6.6		
	VERTICAL	7.6	11.9		
	RESULTANT	11.2	12.4		
E-2	HORIZONTAL				
	VERTICAL				
	RESULTANT				
F-2	HORIZONTAL	7.5	5.3	8.0	6.0
	VERTICAL	7.6	10.8	8.5	10.4
	RESULTANT	10.1	10.8	11.0	10.8
G-3	HORIZONTAL	8.8	4.9	8.7	4.8
	VERTICAL	7.7	10.2	7.3	10.5
	RESULTANT	11.2	10.3	10.8	10.4
H-6	HORIZONTAL	9.6	6.5		
	VERTICAL	7.1	13.1		
	RESULTANT	11.4	13.6		
J-3	HORIZONTAL	7.7	2.6		
	VERTICAL	8.4	5.3		
	RESULTANT	10.5	5.4		
J-4	HORIZONTAL	6.8	4.0	5.2	4.0
	VERTICAL	3.3	9.2	1.6	7.3
	RESULTANT	7.2	8.9	5.2	6.9
K-1	HORIZONTAL	8.1	5.3	8.1	5.0
	VERTICAL	6.4	8.3	5.5	8.1
	RESULTANT	10.0	9.2	9.4	8.7
M13	HORIZONTAL	9.4	3.9		
	VERTICAL	10.0	10.2		
	RESULTANT	13.6	9.6		

TABLE E-1 (CONTINUED)  
 MAXIMUM HEAD AND KNEE DISPLACEMENTS (INCHES)  
 FROM HORIZONTAL TEST PHASE

CELL OF MATRIX		A		B	
SUBJ	DISPLACEMENT	HEAD	KNEE	HEAD	KNEE
P-3	HORIZONTAL			10.3	4.5
	VERTICAL			5.3	8.7
	RESULTANT			11.2	8.5
R-2	HORIZONTAL	9.3	4.0	8.1	3.3
	VERTICAL	7.3	9.0	6.9	8.5
	RESULTANT	11.5	9.1	10.4	8.6
R-3	HORIZONTAL	7.7	5.8	5.2	4.6
	VERTICAL	6.0	10.8	1.8	8.7
	RESULTANT	9.2	10.9	5.7	8.7
T-1	HORIZONTAL			7.3	4.4
	VERTICAL			4.6	9.9
	RESULTANT			8.1	10.0
W-4	HORIZONTAL	9.4	7.0	8.6	7.8
	VERTICAL	7.3	11.7	5.0	8.2
	RESULTANT	11.4	12.4	9.5	9.0

TABLE E-1 (CONTINUED)  
 MAXIMUM HEAD AND KNEE DISPLACEMENTS (INCHES)  
 FROM HORIZONTAL TEST PHASE

CELL OF MATRIX		C		D	
SUBJ	DISPLACEMENT	HEAD	KNEE	HEAD	KNEE
B-1	HORIZONTAL	8.2	2.9	7.4	3.7
	VERTICAL	6.9	7.6	7.6	6.8
	RESULTANT	10.3	7.1	10.5	6.5
B-2	HORIZONTAL	8.6	6.8	8.0	5.2
	VERTICAL	7.2	12.6	6.8	10.3
	RESULTANT	11.2	12.4	10.5	10.0
B-3	HORIZONTAL	5.4	4.2	6.6	4.2
	VERTICAL	4.0	9.5	4.7	7.5
	RESULTANT	6.6	9.5	7.9	7.8
B-4	HORIZONTAL	8.5	3.5	8.3	3.3
	VERTICAL	7.9	9.5	7.2	6.2
	RESULTANT	11.5	7.3	10.9	4.8
C-1	HORIZONTAL				
	VERTICAL				
	RESULTANT				
C-2	HORIZONTAL	8.0	6.0	8.8	4.7
	VERTICAL	7.0	12.3	6.0	9.2
	RESULTANT	10.5	12.7	9.7	9.5
E-2	HORIZONTAL	9.2	5.5	8.2	3.9
	VERTICAL	7.9	12.1	5.8	8.8
	RESULTANT	11.3	11.8	9.4	8.6
F-2	HORIZONTAL	7.7	5.0	7.8	4.1
	VERTICAL	7.7	9.9	6.7	9.0
	RESULTANT	10.2	9.6	9.7	8.8
G-3	HORIZONTAL			7.9	3.8
	VERTICAL			6.6	8.6
	RESULTANT			10.2	8.5
H-6	HORIZONTAL	6.7	4.3		
	VERTICAL	3.5	11.7		
	RESULTANT	7.5	11.9		
J-3	HORIZONTAL	7.3	3.2	8.1	2.3
	VERTICAL	7.7	7.3	8.9	6.9
	RESULTANT	10.0	7.1	11.7	6.5
J-4	HORIZONTAL	4.8	3.3	6.6	3.2
	VERTICAL	2.5	7.2	3.2	6.8
	RESULTANT	4.9	7.2	7.0	6.5
K-1	HORIZONTAL	8.0	4.1	8.3	5.1
	VERTICAL	5.8	7.3	7.6	8.9
	RESULTANT	9.4	7.6	10.9	9.5
M13	HORIZONTAL	8.9	4.2	8.1	1.8
	VERTICAL	9.6	11.2	6.5	5.9
	RESULTANT	12.9	10.2	9.9	4.8

TABLE E-1 (CONTINUED)  
 MAXIMUM HEAD AND KNEE DISPLACEMENTS (INCHES)  
 FROM HORIZONTAL TEST PHASE

CELL OF MATRIX		C		D	
SUBJ	DISPLACEMENT	HEAD	KNEE	HEAD	KNEE
P-3	HORIZONTAL	10.8	4.0	10.9	3.5
	VERTICAL	6.4	8.2	6.1	7.8
	RESULTANT	12.1	8.1	11.8	7.7
R-2	HORIZONTAL	8.9	4.0	8.1	4.2
	VERTICAL	8.8	8.9	7.7	7.9
	RESULTANT	12.0	8.8	11.1	8.0
R-3	HORIZONTAL			6.1	2.8
	VERTICAL			4.9	6.8
	RESULTANT			7.6	6.7
T-1	HORIZONTAL	5.4	2.6	6.4	3.0
	VERTICAL	3.0	8.3	3.9	8.7
	RESULTANT	6.1	8.3	7.1	8.8
W-4	HORIZONTAL	8.4	6.6	6.7	4.3
	VERTICAL	5.7	12.1	2.3	8.6
	RESULTANT	9.6	12.2	6.8	8.4

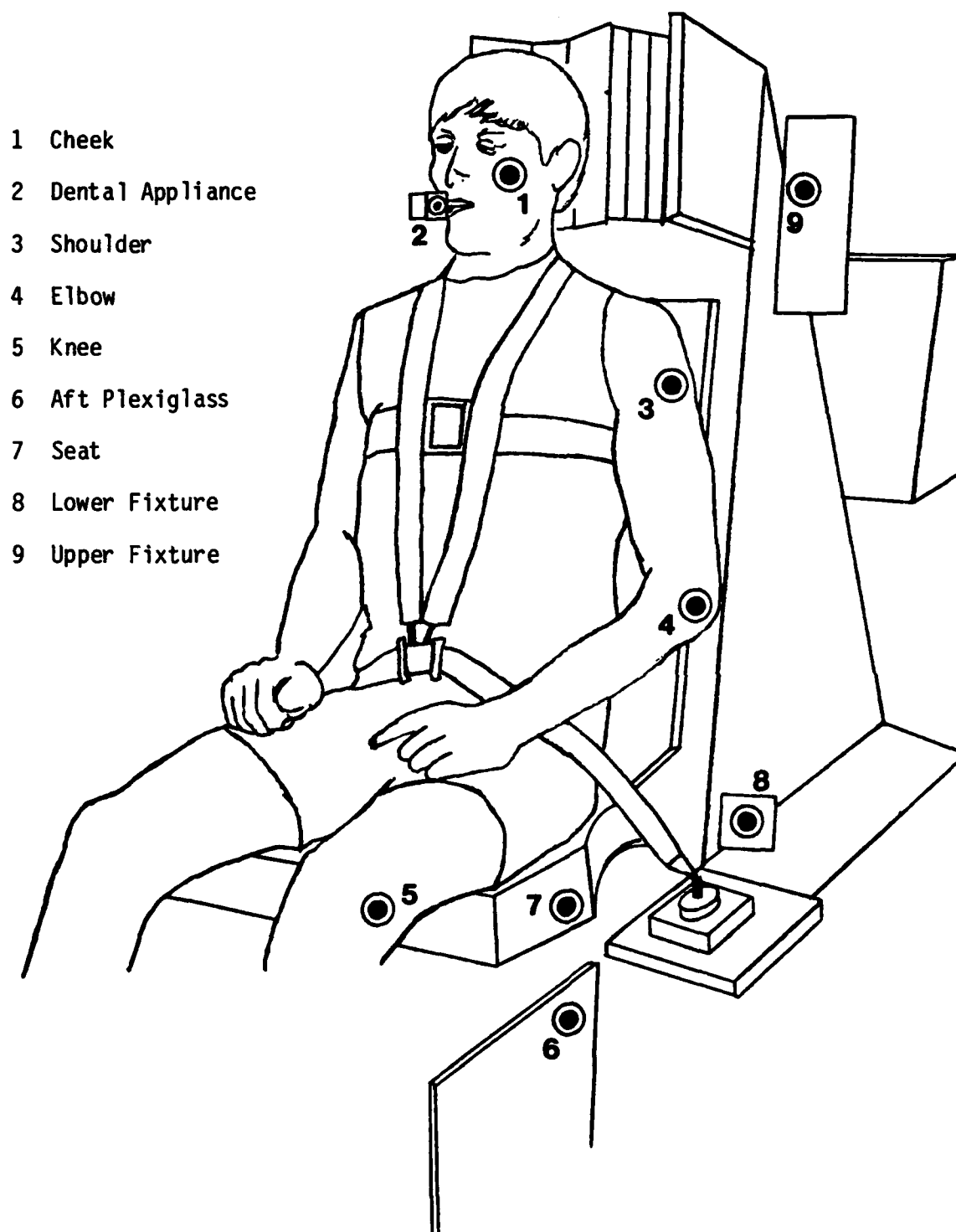
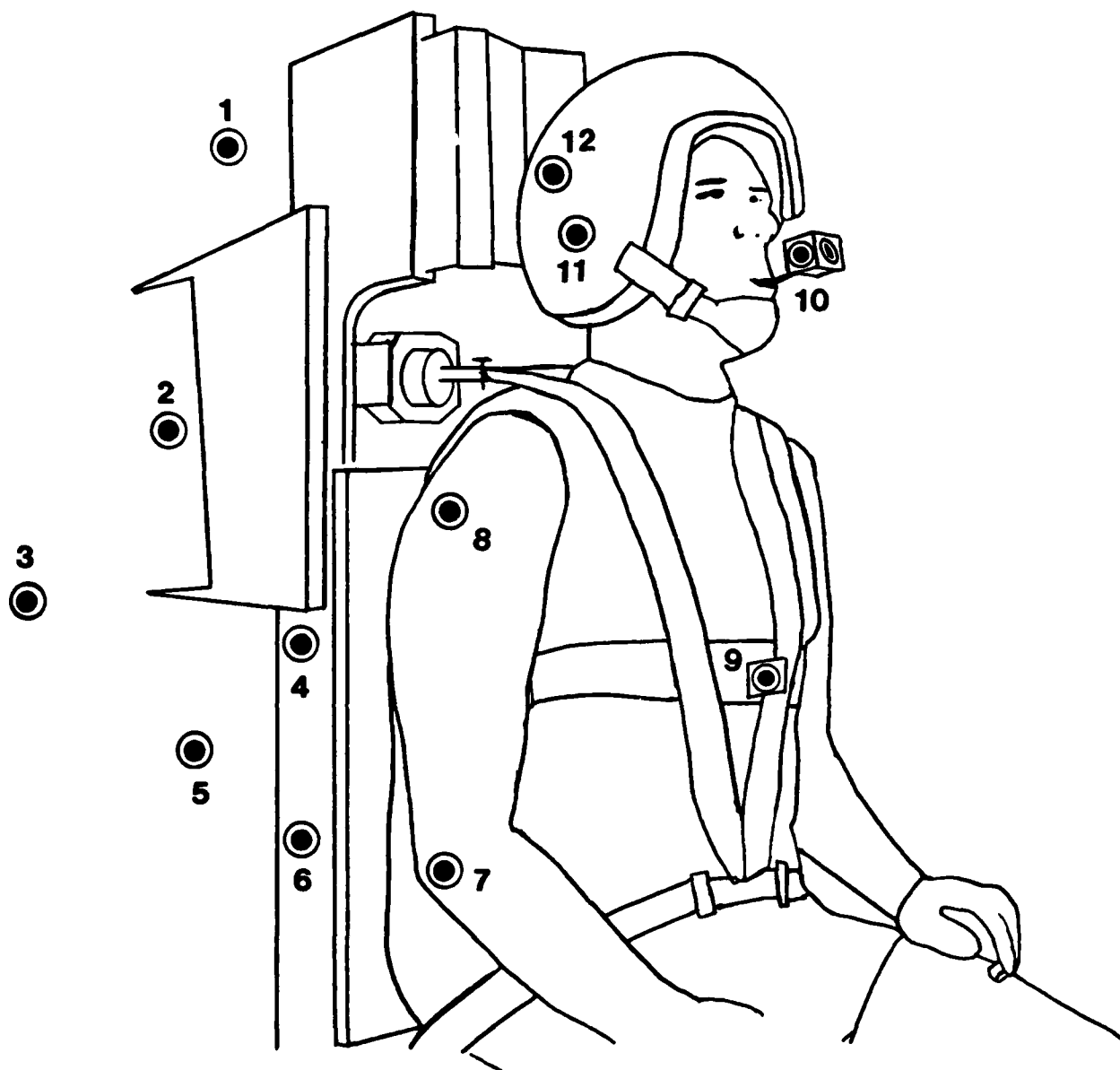


Figure E-1. Target Placement During Horizontal Test Phase



- |                      |                       |
|----------------------|-----------------------|
| 1 Upper Carriage     | 7 Elbow               |
| 2 Upper Left Frame   | 8 Shoulder            |
| 3 Center Carriage    | 9 Chest Accelerometer |
| 4 Center Right Frame | 10 Dental Appliance   |
| 5 Lower Left Frame   | 11 Lower Helmet       |
| 6 Lower Right Frame  | 12 Upper Helmet       |

Figure E-2. Target Placement During Vertical Test Phase



# WILCOXON COMPARISON A-B

## ANALYSIS OF VERTICAL HEAD DISPLACEMENT

(IMPACT MAXIMUM)

SUBJ	A CELL VALUE	B CELL VALUE	DIFFERENCE (A - B)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
B-1	7.50	6.66	0.84	4.00	0.00	4.00
B-3	5.03	5.56	-0.53	3.00	3.00	0.00
C-1	8.91	7.02	1.89	8.00	0.00	8.00
F-2	7.64	8.51	-0.87	6.00	6.00	0.00
G-3	7.74	7.29	0.45	2.00	0.00	2.00
J-4	3.29	1.65	1.64	7.00	0.00	7.00
K-1	6.38	5.53	0.85	5.00	0.00	5.00
A-2	7.29	6.86	0.43	1.00	0.00	1.00
A-3	5.99	1.82	4.17	10.00	0.00	10.00
W-4	7.32	4.99	2.33	9.00	0.00	9.00

MEAN A: 6.71 STD DEV A: 1.61 SUM OF NEG RANKS: 9.00 -----  
 MEAN B: 5.59 STD DEV B: 2.27 SUM OF POS RANKS: ----- 46.00

THERE IS A 20% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.10$ ).

# WILCOXON COMPARISON A-B

## ANALYSIS OF RESULTANT HEAD DISPLACEMENT

(IMPACT MAXIMUM)

SUBJ	A CELL VALUE	B CELL VALUE	DIFFERENCE (A - B)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
B-1	10.62	10.16	0.46	2.00	0.00	2.00
B-3	8.40	8.81	-0.41	1.00	1.00	0.00
C-1	12.88	10.97	1.91	7.00	0.00	7.00
F-2	10.06	10.96	-0.90	5.00	5.00	0.00
G-3	11.22	10.75	0.47	3.00	0.00	3.00
J-4	7.24	5.20	2.04	9.00	0.00	9.00
K-1	10.00	9.42	0.58	4.00	0.00	4.00
A-2	11.47	10.36	1.11	6.00	0.00	6.00
A-3	9.24	5.65	3.59	10.00	0.00	10.00
W-4	11.41	9.48	1.93	8.00	0.00	8.00

MEAN A: 10.25 STD DEV A: 1.65 SUM OF NEG RANKS: 6.00 -----  
 MEAN B: 9.18 STD DEV B: 2.10 SUM OF POS RANKS: ----- 49.00

THERE IS A 12% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.05$ ).

# WILCOXON COMPARISON A-B

## ANALYSIS OF VERTICAL KNEE DISPLACEMENT

(IMPACT MAXIMUM)

SUBJ	A CELL VALUE	B CELL VALUE	DIFFERENCE (A - B)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
B-1	8.21	7.76	0.45	4.00	0.00	4.00
B-3	8.24	9.75	-1.51	6.00	6.00	0.00
C-1	10.25	7.64	2.61	10.00	0.00	10.00
F-2	10.82	10.43	0.39	3.00	0.00	3.00
G-3	10.23	10.54	-0.31	2.00	2.00	0.00
J-4	9.20	7.33	1.87	7.00	0.00	7.00
K-1	8.33	8.10	0.23	1.00	0.00	1.00
A-2	9.01	8.52	0.49	5.00	0.00	5.00
A-3	10.84	8.66	2.18	8.00	0.00	8.00
W-4	11.74	9.24	2.50	9.00	0.00	9.00

MEAN A: 9.69 STD DEV A: 1.26 SUM OF NEG RANKS: 8.00 -----  
 MEAN B: 8.80 STD DEV B: 1.15 SUM OF POS RANKS: ----- 47.00

THERE IS A 10% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.05$ ).

# WILCOXON COMPARISON A-B

## ANALYSIS OF RESULTANT KNEE DISPLACEMENT

(IMPACT MAXIMUM)

SUBJ	A CELL VALUE	B CELL VALUE	DIFFERENCE (A - B)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
B-1	7.66	7.53	0.13	2.00	0.00	2.00
B-3	8.31	10.26	-1.95	5.00	5.00	0.00
C-1	10.05	7.51	2.54	8.00	0.00	8.00
F-2	10.78	10.78	0.00	0.00	0.00	0.00
G-3	10.29	10.41	-0.12	1.00	1.00	0.00
J-4	8.95	6.88	2.07	6.00	0.00	6.00
K-1	9.22	8.74	0.48	3.00	0.00	3.00
A-2	9.14	8.59	0.55	4.00	0.00	4.00
A-3	10.86	8.66	2.20	7.00	0.00	7.00
W-4	12.40	8.98	3.42	9.00	0.00	9.00

MEAN A: 9.77 STD DEV A: 1.39 SUM OF NEG RANKS: 6.00 -----  
 MEAN B: 8.83 STD DEV B: 1.32 SUM OF POS RANKS: ----- 39.00

THERE IS A 11% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.10$ ).

# WILCOXON COMPARISON C-D

## ANALYSIS OF HORIZONTAL KNEE DISPLACEMENT

(IMPACT MAXIMUM)

SUBJ	C CELL VALUE	D CELL VALUE	DIFFERENCE (C - D)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
B-1	2.88	3.68	-0.80	7.00	7.00	0.00
B-2	6.76	5.16	1.60	13.00	0.00	13.00
B-3	4.15	4.16	-0.01	1.00	1.00	0.00
B-4	3.50	3.35	0.15	3.00	0.00	3.00
C-2	5.96	4.69	1.27	11.00	0.00	11.00
E-2	5.51	3.91	1.60	12.00	0.00	12.00
F-2	5.03	4.13	0.90	9.00	0.00	9.00
J-3	3.19	2.33	0.86	8.00	0.00	8.00
J-4	3.29	3.22	0.07	2.00	0.00	2.00
K-1	4.10	5.11	-1.01	10.00	10.00	0.00
M13	4.23	1.77	2.46	15.00	0.00	15.00
P-3	4.01	3.52	0.49	6.00	0.00	6.00
A-2	3.96	4.16	-0.20	4.00	4.00	0.00
T-1	2.58	2.95	-0.37	5.00	5.00	0.00
W-4	6.56	4.34	2.22	14.00	0.00	14.00

MEAN C: 4.38 STD DEV C: 1.31 SUM OF NEG RANKS: 27.00 -----  
 MEAN D: 3.77 STD DEV D: 0.95 SUM OF POS RANKS: ----- 93.00

THERE IS A 16% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.10$ ).

# WILCOXON COMPARISON C-D

## ANALYSIS OF VERTICAL KNEE DISPLACEMENT

(IMPACT MAXIMUM)

SUBJ	C CELL VALUE	D CELL VALUE	DIFFERENCE (C - D)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
B-1	7.59	6.81	0.78	5.00	0.00	5.00
B-2	12.59	10.27	2.32	10.00	0.00	10.00
B-3	9.48	7.52	1.96	9.00	0.00	9.00
B-4	9.48	6.15	3.33	13.00	0.00	13.00
C-2	12.30	9.23	3.07	11.00	0.00	11.00
E-2	12.05	8.77	3.28	12.00	0.00	12.00
F-2	9.93	9.01	0.92	6.00	0.00	6.00
J-3	7.29	6.86	0.43	2.00	0.00	2.00
J-4	7.17	6.84	0.33	1.00	0.00	1.00
K-1	7.28	8.91	-1.63	8.00	8.00	0.00
M13	11.17	5.91	5.26	15.00	0.00	15.00
P-3	8.22	7.76	0.46	4.00	0.00	4.00
A-2	8.85	7.86	0.99	7.00	0.00	7.00
T-1	8.27	8.72	-0.45	3.00	3.00	0.00
W-4	12.14	8.55	3.59	14.00	0.00	14.00

MEAN C: 9.59 STD DEV C: 2.00 SUM OF NEG RANKS: 11.00 -----  
 MEAN D: 7.94 STD DEV D: 1.25 SUM OF POS RANKS: ----- 109.00

THERE IS A 21% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON C-D

## ANALYSIS OF RESULTANT KNEE DISPLACEMENT

(IMPACT MAXIMUM)

SUBJ	C CELL VALUE	D CELL VALUE	DIFFERENCE (C - D)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
B-1	7.09	6.54	0.55	3.00	0.00	3.00
B-2	12.45	10.00	2.45	10.00	0.00	10.00
B-3	9.53	7.79	1.74	8.00	0.00	8.00
B-4	7.34	4.81	2.53	11.00	0.00	11.00
C-2	12.66	9.51	3.15	12.00	0.00	12.00
E-2	11.79	8.55	3.24	13.00	0.00	13.00
F-2	9.59	8.84	0.75	6.00	0.00	6.00
J-3	7.12	6.46	0.66	4.00	0.00	4.00
J-4	7.21	6.50	0.71	5.00	0.00	5.00
K-1	7.62	9.52	-1.90	9.00	9.00	0.00
M13	10.24	4.84	5.40	15.00	0.00	15.00
P-3	8.11	7.73	0.38	1.00	0.00	1.00
R-2	8.79	7.98	0.81	7.00	0.00	7.00
T-1	8.25	8.76	-0.51	2.00	2.00	0.00
W-4	12.18	8.43	3.75	14.00	0.00	14.00

MEAN C: 9.33 STD DEV C: 2.07 SUM OF NEG RANKS: 11.00  
 MEAN D: 7.75 STD DEV D: 1.61 SUM OF POS RANKS: 109.00

THERE IS A 20% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON A-C

## ANALYSIS OF HORIZONTAL HEAD DISPLACEMENT

(IMPACT MAXIMUM)

SUBJ	A CELL VALUE	C CELL VALUE	DIFFERENCE (A - C)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
B-1	8.25	8.24	0.01	1.00	0.00	1.00
B-3	7.12	5.45	1.67	9.00	0.00	9.00
C-2	9.12	8.02	1.10	8.00	0.00	8.00
F-2	7.50	7.73	-0.23	3.00	3.00	0.00
H-6	9.65	6.70	2.95	11.00	0.00	11.00
J-3	7.71	7.30	0.41	5.00	0.00	5.00
J-4	6.85	4.75	2.10	10.00	0.00	10.00
K-1	8.13	7.99	0.14	2.00	0.00	2.00
M13	9.41	8.89	0.52	6.00	0.00	6.00
R-2	9.28	8.95	0.33	4.00	0.00	4.00
W-4	9.41	8.43	0.98	7.00	0.00	7.00

MEAN A: 8.40 STD DEV A: 1.02 SUM OF NEG RANKS: 3.00  
 MEAN C: 7.50 STD DEV C: 1.36 SUM OF POS RANKS: 63.00

THERE IS A 12% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON A-C

## ANALYSIS OF VERTICAL HEAD DISPLACEMENT

(IMPACT MAXIMUM)

SUBJ	A CELL VALUE	C CELL VALUE	DIFFERENCE (A - C)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
B-1	7.50	6.86	0.64	5.00	0.00	5.00
B-3	5.03	3.98	1.05	8.00	0.00	8.00
C-2	7.56	6.98	0.58	3.00	0.00	3.00
F-2	7.64	7.74	-0.10	1.00	1.00	0.00
H-6	7.05	3.45	3.60	11.00	0.00	11.00
J-3	8.40	7.73	0.67	6.00	0.00	6.00
J-4	3.29	2.52	0.77	7.00	0.00	7.00
K-1	6.38	5.76	0.62	4.00	0.00	4.00
M13	10.04	9.64	0.40	2.00	0.00	2.00
R-2	7.29	8.78	-1.49	9.00	9.00	0.00
W-4	7.32	5.71	1.61	10.00	0.00	10.00

MEAN A: 7.05 STD DEV A: 1.74 SUM OF NEG RANKS: 10.00  
 MEAN C: 6.29 STD DEV C: 2.25 SUM OF POS RANKS: 56.00

THERE IS A 12% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.05$ ).

# WILCOXON COMPARISON A-C

## ANALYSIS OF RESULTANT HEAD DISPLACEMENT

(IMPACT MAXIMUM)

SUBJ	A CELL VALUE	C CELL VALUE	DIFFERENCE (A - C)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
B-1	10.62	10.25	0.37	2.00	0.00	2.00
B-3	8.40	6.56	1.84	8.00	0.00	8.00
C-2	11.16	10.51	0.65	6.00	0.00	6.00
F-2	10.06	10.21	-0.15	1.00	1.00	0.00
H-6	11.44	7.46	3.98	11.00	0.00	11.00
J-3	10.52	10.00	0.52	3.00	0.00	3.00
J-4	7.24	4.88	2.36	10.00	0.00	10.00
K-1	10.00	9.42	0.58	5.00	0.00	5.00
M13	13.62	12.88	0.74	7.00	0.00	7.00
R-2	11.47	12.02	-0.55	4.00	4.00	0.00
W-4	11.41	9.56	1.85	9.00	0.00	9.00

MEAN A: 10.54 STD DEV A: 1.68 SUM OF NEG RANKS: 5.00  
 MEAN C: 9.43 STD DEV C: 2.33 SUM OF POS RANKS: 61.00

THERE IS A 11% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON A-C

## ANALYSIS OF HORIZONTAL KNEE DISPLACEMENT

(IMPACT MAXIMUM)

SUBJ	A CELL VALUE	C CELL VALUE	DIFFERENCE (A - C)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
B-1	4.64	2.88	1.76	10.00	0.00	10.00
B-3	5.16	4.15	1.01	8.00	0.00	8.00
C-2	6.60	5.96	0.64	6.00	0.00	6.00
F-2	5.26	5.03	0.23	2.00	0.00	2.00
H-6	6.51	4.29	2.22	11.00	0.00	11.00
J-3	2.56	3.19	-0.63	5.00	5.00	0.00
J-4	4.00	3.29	0.71	7.00	0.00	7.00
K-1	5.26	4.10	1.16	9.00	0.00	9.00
M13	3.86	4.23	-0.37	3.00	3.00	0.00
A-2	4.04	3.96	0.08	1.00	0.00	1.00
W-4	6.99	6.56	0.43	4.00	0.00	4.00

MEAN A: 4.99 STD DEV A: 1.35 SUM OF NEG RANKS: 8.00 -----  
 MEAN C: 4.33 STD DEV C: 1.13 SUM OF POS RANKS: ----- 58.00

THERE IS A 15% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.05$ ).

# WILCOXON COMPARISON B-D

## ANALYSIS OF HORIZONTAL KNEE DISPLACEMENT

(IMPACT MAXIMUM)

SUBJ	B CELL VALUE	D CELL VALUE	DIFFERENCE (B - D)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
B-1	4.23	3.68	0.55	2.00	0.00	2.00
B-2	7.07	5.16	1.91	11.00	0.00	11.00
B-3	6.16	4.16	2.00	12.00	0.00	12.00
F-2	6.02	4.13	1.89	10.00	0.00	10.00
G-3	4.75	3.83	0.92	6.00	0.00	6.00
J-4	3.96	3.22	0.74	4.00	0.00	4.00
K-1	4.99	5.11	-0.12	1.00	1.00	0.00
P-3	4.50	3.52	0.98	7.00	0.00	7.00
A-2	3.25	4.16	-0.91	5.00	5.00	0.00
A-3	4.57	2.85	1.72	9.00	0.00	9.00
T-1	4.39	2.95	1.44	8.00	0.00	8.00
W-4	4.94	4.34	0.60	3.00	0.00	3.00

MEAN B: 4.90 STD DEV B: 1.05 SUM OF NEG RANKS: 6.00 -----  
 MEAN D: 3.93 STD DEV D: 0.74 SUM OF POS RANKS: ----- 72.00

THERE IS A 25% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON B-D

## ANALYSIS OF VERTICAL KNEE DISPLACEMENT

(IMPACT MAXIMUM)

SUBJ	B CELL VALUE	D CELL VALUE	DIFFERENCE (B - D)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
B-1	7.76	6.81	0.95	6.00	0.00	6.00
B-2	11.55	10.27	1.28	8.00	0.00	8.00
B-3	9.75	7.52	2.23	12.00	0.00	12.00
F-2	10.43	9.01	1.42	9.00	0.00	9.00
G-3	10.54	8.64	1.90	11.00	0.00	11.00
J-4	7.33	6.84	0.49	1.00	0.00	1.00
K-1	8.10	8.91	-0.81	4.00	4.00	0.00
P-3	8.70	7.76	0.94	5.00	0.00	5.00
A-2	8.52	7.86	0.66	2.00	0.00	2.00
A-3	8.66	6.82	1.84	10.00	0.00	10.00
T-1	9.91	8.72	1.19	7.00	0.00	7.00
W-4	9.24	8.55	0.69	3.00	0.00	3.00

MEAN B: 9.21 STD DEV B: 1.26 SUM OF NEG RANKS: 4.00  
 MEAN D: 8.14 STD DEV D: 1.06 SUM OF POS RANKS: 74.00

THERE IS A 13% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

# WILCOXON COMPARISON B-D

## ANALYSIS OF RESULTANT KNEE DISPLACEMENT

(IMPACT MAXIMUM)

SUBJ	B CELL VALUE	D CELL VALUE	DIFFERENCE (B - D)	RANK OF DIFFERENCE	SIGNED RANK (NEG)	SIGNED RANK (POS)
B-1	7.53	6.54	0.99	6.00	0.00	6.00
B-2	11.01	10.00	1.01	7.00	0.00	7.00
B-3	10.26	7.79	2.47	12.00	0.00	12.00
F-2	10.78	8.84	1.94	11.00	0.00	11.00
G-3	10.41	8.53	1.88	9.00	0.00	9.00
J-4	6.88	6.50	0.38	1.00	0.00	1.00
K-1	8.74	9.52	-0.78	4.00	4.00	0.00
P-3	8.54	7.73	0.81	5.00	0.00	5.00
A-2	8.59	7.98	0.61	3.00	0.00	3.00
A-3	8.66	6.74	1.92	10.00	0.00	10.00
T-1	10.01	8.76	1.25	8.00	0.00	8.00
W-4	8.98	8.43	0.55	2.00	0.00	2.00

MEAN B: 9.20 STD DEV B: 1.30 SUM OF NEG RANKS: 4.00  
 MEAN D: 8.11 STD DEV D: 1.13 SUM OF POS RANKS: 74.00

THERE IS A 13% INCREASE IN THE PARAMETER MEAN ( $2\alpha \leq 0.01$ ).

## REFERENCES

Baumann, R., J. W. Brinkley, and A. Brandau, 1968, "Back Injuries Experienced During Ejection Seat Testing", AMRL-TR-68-82, Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio.

Beeding, E. and J. Mosely, January 1960, Human Deceleration Tests, AFMDC-TN-60-2, Air Force Missile Development Center, Holloman Air Force Base, New Mexico.

Beeding, E., July 1960, Daisy Decelerator Tests 520-707 (13 July 1959 - 13 April 1960), USAF Missile Development Center, Holloman AFB, NM, MDW Test Report No. 60-4.

Beeding, E., 1961, "Human Forward-Facing Impact Tolerance", Aerospace Medicine, 32(3): 220.

Brinkley, J. W. and J. T. Shaffer, 1971, "Restraint Design: Laboratory Test and Evaluation of Operational Effectiveness" in Linear Acceleration (Impact Type), AGARD Conference Pre-print No. 88.

Brinkley, J. W., J. H. Raddin, Jr., B. F. Hearon, L. A. McGowan, and J. M. Powers, November 1981, Evaluation of a Proposed, Modified F/FB-111 Crew Seat and Restraint System, AFAMRL-TR-80-52, Air Force Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio.

Brinkley, J. W., B. F. Hearon, J. H. Raddin, Jr., L. A. McGowan, and J. M. Powers, August 1982, Vertical Impact Tests of a Modified F/FB-111 Crew Seat to Evaluate Headrest Position and Restraint Configuration Effects, AFAMRL-TR-82-51, Air Force Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio.

Desjardins, S. P. and D. H. Laananen, June 1980, Aircraft Crash Survival Design Guide - Volume IV, USARTL-TR-79-22D, United States Army Research and Technology Laboratories (AVRADCOM), Fort Eustis, Virginia.

Ensor, L. C., 1970, "Accelerometer Calibration with Reciprocity Vibration Standards" in Measurements and Data, Endevco Technical Paper No. 251, San Juan Capistrano, California.

Gadd, C. W., 1966, "Use of Weighted Impulse Criterion for Estimating Injury Hazard" in Tenth Stapp Car Crash Conference, Society of Automotive Engineers, Inc., New York.

Graf, P. A., H. T. Mohlman, and R. C. Reboulet, October 1978, Photometric Methods for the Analysis of Human Kinematic Responses to Impact Environments, AMRL-TR-78-94 (ADA-062006), Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio.

Hearon, B. F. and J. H. Raddin, Jr., 1981, "Experience with Highly Selective Screening Techniques for Acceleration Stress Duty" in The Effect of Long-Term Therapeutics, Prophylaxis and Screening Techniques on Aircrew Medical Standards, AGARD-CP-310, Toronto, Canada.



Hearon, B. F., 1981, F/FB-111 Ejection Experience (1967-1980) - Part 2: Summary of Accident Investigation Reports, AFAMRL-TR-81-114, Air Force Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio.

Hearon, B. F., H. A. Thomas, and J. H. Raddin, Jr., 1982, "Mechanism of Vertebral Fracture in the F/FB-111 Ejection Experience" in Aviation, Space and Environmental Medicine, 53(5): 440-48.

Hearon, B. F., J. W. Brinkley, and J. H. Raddin, Jr., 1983, "Vertical Impact Evaluation of the F/FB-111 Crew Restraint Configuration, Headrest Position, and Upper Extremity Bracing Technique" in Aviation, Space and Environmental Medicine, 54(11): 977-987.

Leupp, D. G. and J. W. Frazier, 1982, ACES II Negative G, Restraint Investigation, Air Force Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio.

Lovelace, R., E. Baldes, and V. Wulff, August 1945, The Ejection Seat for Emergency Escape from High-Speed Aircraft, Memorandum Report TSEAL-3-696-74C, Air Technical Service Command, Wright Field, Dayton, Ohio.

Majewski, P., T. Borgman, D. Thomas, and C. Ewing, November 1978, "Transient Intraventricular Conduction Defects Observed During Experimental Impact in Human Subjects" in AGARD-CPP-253.

Reader, D. C., March 1979, "Head Acceleration and Psychomotor Performance" in Aviation Space and Environmental Medicine, 50(3): 267-270.

Rhein, L. and E. Taylor, August 1962, Relative Bradycardia After Impact, ARL-TDR-62-12, 6571st Aeromedical Research Laboratory, Holloman Air Force Base, New Mexico.

Stapp, J., December 1951, Human Exposures to Linear Deceleration: Part 2 - The Forward-Facing Position and the Development of a Crash Harness, AF Technical Report No. 5914, Part 2, Wright Air Development Center, Wright-Patterson Air Force Base, Ohio.

Taylor, E., L. Rhein, and G. Beers, August 1962, Effect of Atropine Upon the Relative Bradycardia Associated with Impact, ARL-TDR-62-13, 6571st Aeromedical Research Laboratory, Holloman Air Force Base, New Mexico.

Wilcoxon, F. and R. A. Wilcox, 1964, Some Rapid Approximate Statistical Procedures, Lederle Laboratories, New York.

END

FILMED

4-84

DTIC